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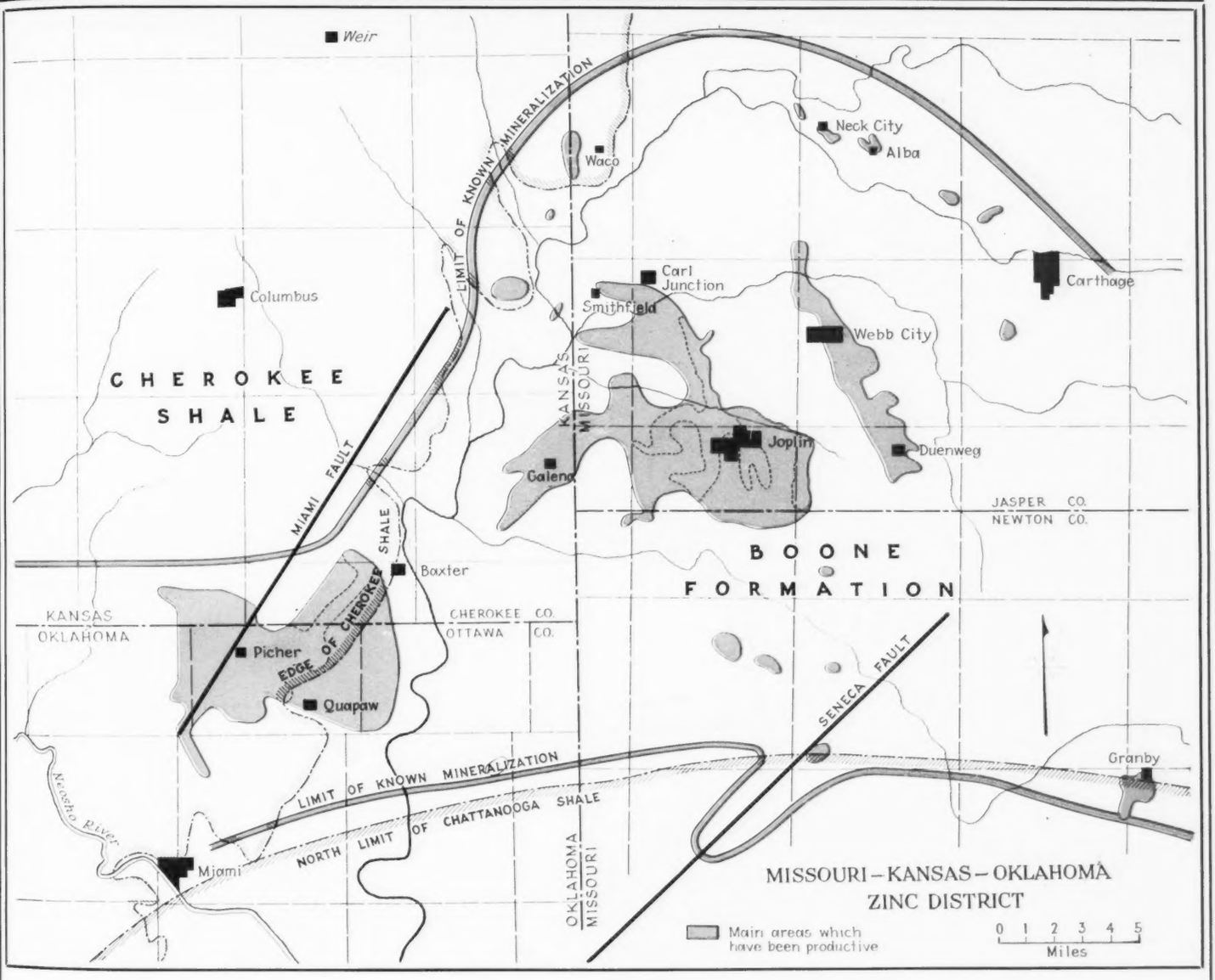

The Oklahoma - Kansas - Missouri Zinc - Lead Field

By Foster S. Naething

MORE than a third of the world's zinc comes from the deposits shown in color in the map above. Most of the activity in the last few years has been in the high-grade mineralized area around Picher, Oklahoma

Repair and Maintenance Work at Magna Mill
By George J. Young

Lessons from a Hoisting Accident
By Letson Balliet

Sources of Error In Assaying Tin Ores
By Gerald U. Greene

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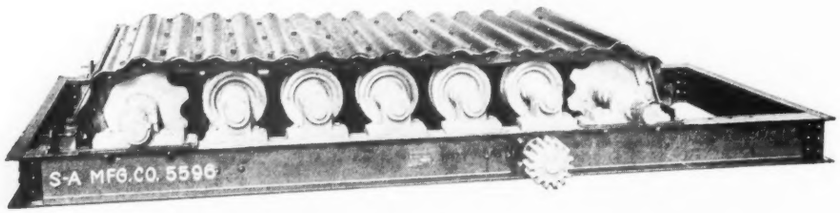

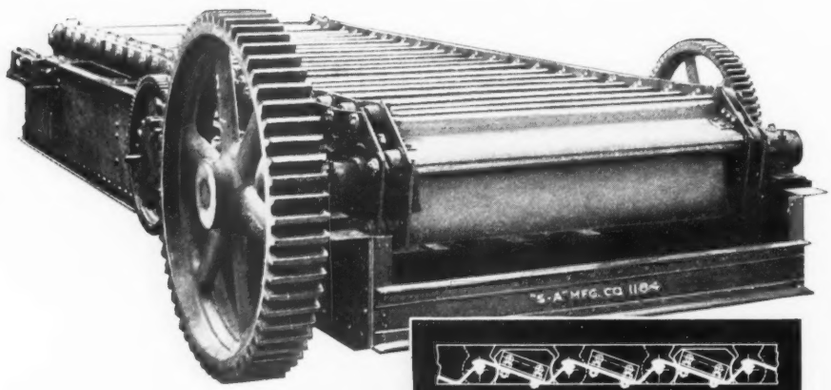

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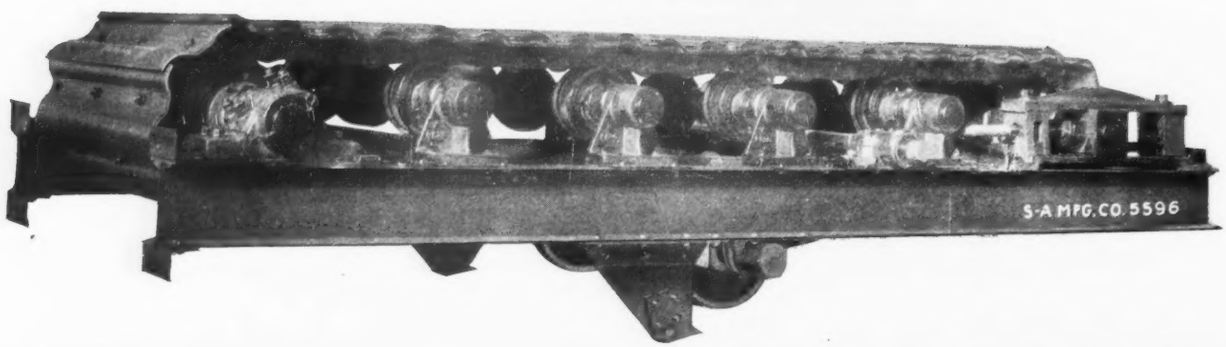

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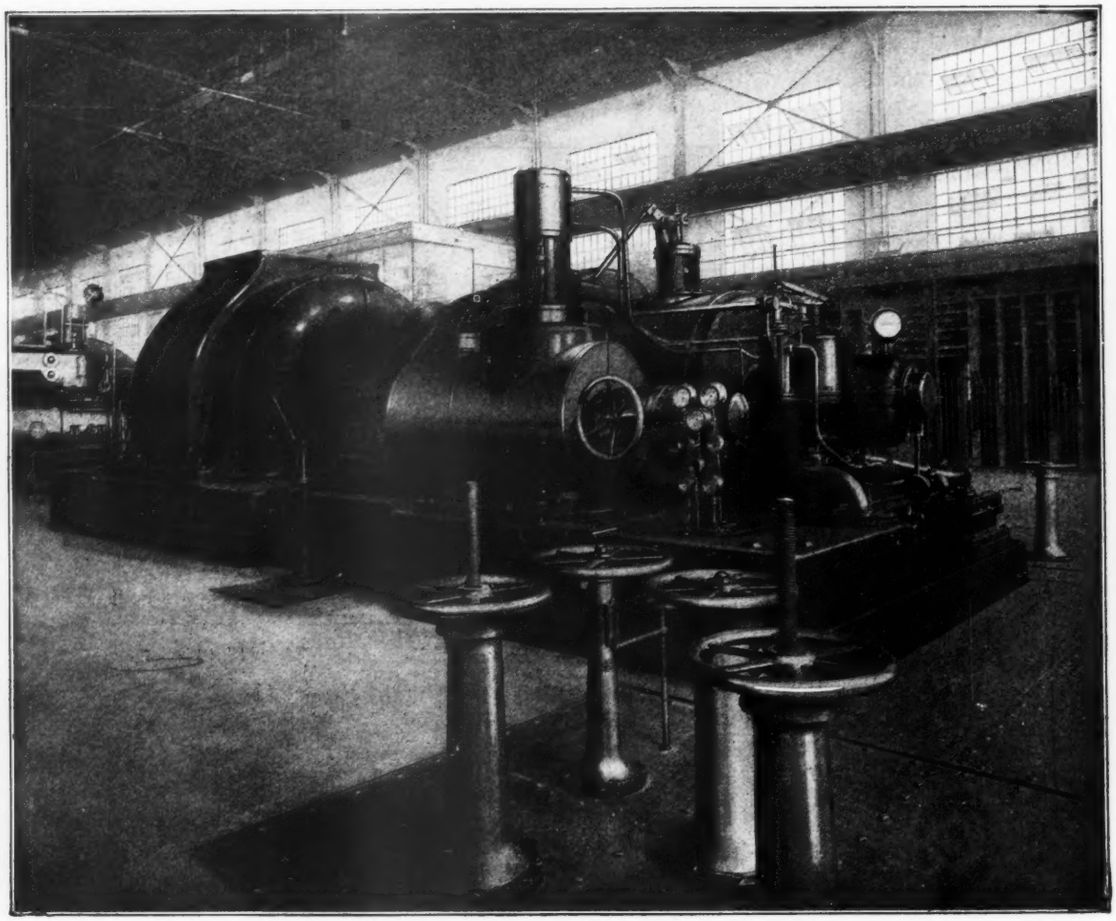

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

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The European Manganese Situation

LAST WEEK *The New York Times* carried a story from Paris to the effect that the Harriman group which last year secured the manganese concessions in the Caucasus from the Russian Government would sell out its interest to the newly formed European iron and steel trust. The reasons assigned were that a part of the expected American market had turned to Brazilian sources of supply; that unexpected competition had arisen in Germany; that difficulties had arisen with the Communists in Russia; and that general conditions in the manganese industry are not favorable. *Engineering and Mining Journal* has been told officially in New York that the story published in the *Times* is without basis in fact. However, it seems probable that this is a case where the smoke is caused by at least an incipient fire.

Competition is very keen in the manganese industry, with ample sources of supply in several countries, notably Brazil, India, and the Gold Coast of Africa, in addition to the Georgian deposits. Prices have dropped materially since the Harriman concessions were granted, and in the last few months it has been rumored that manganese ore has sold at 30c. per long ton unit of manganese, or even less, compared with 40c. and more a year or two ago. At English ports, the price is said to have fallen from 20@21d. to 15d. This decline in price would make the business much less attractive than when the agreement with the Soviet authorities was entered into, by the American interests about a year and a half ago.

Then, too, it is understood that the Soviet government has not been altogether pleased with its bargain; that the royalty of $4 per ton now received is no more than was netted from taxes and other charges under the previous method of operation. Many of the mines have been closed down, throwing thousands of workmen out of employment, and some of the private owners are said to be disgruntled. Exports for the first year were only about 380,000 tons, some 200,000 tons less than was reported to have been agreed upon. Of course, it takes time to carry out experiments, install new processes and equipment, and bring the industry up to the high standard that would be expected of an American company operating on a larger scale, and it may be presumed that many of the unfavorable features that have been evident in the first year will gradually disappear.

Whether or not the Harriman interests are anxious to sell, it would seem in order for the European steel consortium to be anxious about an assured supply of manganese. England has no hand in this cartel, and controls the deposits in India and the Gold Coast; the Brazilian production finds most of its market in the United States and is to some extent controlled here. This leaves the Georgian deposits as a logical source of supply for the Franco-German group, and efforts are no doubt being made to make favorable contracts for manganese ore from that source, if not for an actual controlling interest in the concession.

The Prospector

A RECENT ARTICLE in a magazine of the "popular-intellectual" type describes the residual Western prospector. He is described as a tough, hardy old specimen, who in the past has promptly wasted on dissipation of the crudest sort any windfall of funds which has come to him; and who survives in the hope of another lump of cash, so that he can dispose of it in a similar roistering manner. Such types no doubt exist —but they do not typify the average prospector, who no doubt is passing away in the United States.

The recollection of a long personal acquaintance with prospectors pictures them as a wonderfully varied and interesting class—as fine and lovable a group, perhaps, as one can find. They were gathered from every walk in life—some highly educated, with a past record of busy life in cities: some with no education—past farmers, or trappers, or sailors. Many were philosophers—deep and balanced thinkers, and appreciative readers of literature and science. As a class they were competent and courageous, and as a class most hospitable and free-handed. If they were disposed, in case of stress, to rely for protection and their rights on the persuasive power of a rifle—rarely used except as a gesture—it was because they lived so long in places where the rifle was their only protection against wrong and violence, not in the least because they were other than most peaceably-minded.

Prospectors as a rule loved the life—its peace, its adventure, its freedom, its unlimited hopes. But if they struck it rich, most of them were prudent, and retained their prosperity, and became bankers, or ranchers, or real-estate operators, or financiers—take it all in all, a fine breed. Their tendency to "cut loose" in town, so much exaggerated by the article referred to in the beginning, was perhaps about that of the average citizen of all walks of life. Their normal life was cooking serenely in their log cabins; loading their burros with drills and powder; and pounding the drills into the heart of the mountains day in and day out, week in and week out, so long as the grub lasted.

The race is not dead—there are plenty of them yet. Many of them, when there is nothing else to do, sit down and write a letter to the Editor; and no class of correspondence brings more cheer and interest.

Cornwall vs. Chile as Copper Producers

THE PRODUCERS OF COPPER in Cornwall and Swansea had visions as early as 1836 of being cut out of the London market by increased production of copper in Chile. On Sept. 10, 1836, the *Mining Journal* (London) gave the Cornwall production of copper in 1836 as 11,639 tons, and for 1835 it was 12,271 tons. The production for Swansea in 1836 was 3,839 tons, compared with 2,832 tons in 1835, an increase of 1,000 tons, mainly from Chile. The *Journal* suggested "the moment seems to us a fitting one to consider the propriety of a duty being imposed on foreign ores. . . . It is sufficient on the present occasion to direct attention to the subject. The ores sold at Swansea, being mainly those of Cuba and Chile, . . . must in the end tend seriously to affect our mines."

How the above statement has come true is shown by production figures for 1924, wherein the United Kingdom is given credit for 125 metric tons of copper, while for the same year Chile produced 190,380 tons, and her neighbor Peru, 34,923 tons. Since 1836 the Cornish mines have become exhausted so that they cannot compete with foreign copper. Production in the United States was a negligible factor in those early days; Chile, Mexico, and Peru were very small producers; Katanga was unknown, and Rhodesia was an unexplored wilderness. Varied and many are the geographic locations where copper is produced today. Cornwall has long lost her prestige as a copper producer, but her sons are among the world's best miners.

The Company He Keeps

INSTEAD OF GROWING MILDER, the bleeding of the public by unloading upon them at a fabulous price stock in mines which are mere holes in the ground seems to thrive. Chief among such shovers of the queer is still George Graham Rice, working through his medium of publicity, *The Iconoclast*, and various other selling devices. The Idaho Copper Corporation, characterized in no uncertain terms by the State Mine Inspector of Idaho as offering no adequate basis for the price at which the stock is being unloaded on the public, is well known. Rice, whose methods are brazen, is now suing the State Mine Inspector as a consequence of this statement, which appears to be quite correct. Another of the stocks which is being unloaded on the public is that of the Colombia Emerald Development Corporation, capitalized at 1,000,000 shares, par value $5. This mine is a very small operation, and has not up to date been encouraging; yet the stock has been kited and sold by the flamboyant representations of *The Iconoclast* at several times the par value mentioned.

The most discouraging thing about the situation is the evidence that men who are worthy of better deeds and more respectable associations are willing to make connections with Rice and profit by his clever salesmanship. The acceptance of a position as manager of the Idaho Copper Corporation by Walter Harvey Weed, a geologist of ability, was much regretted by the fraternity of mining engineers and geologists. Equally striking are the associations involved in the Colombia Emerald Development Corporation stock campaign. *The Iconoclast* features, and uses as an inducement to the public to buy, the fact that this mine is controlled and managed by the "Lewisohn interests," which in this case appears to mean Frederick Lewisohn, and not his uncle Adolph Lewisohn.

It is unfortunate that a name—Lewisohn—which stands for real achievement in mining should be associated with one—Rice—which stands only for selling questionable stocks to an ignorant public.

Are Canadian Mining Shares Over-Valued?

SUBSTANTIAL—in some instances phenomenal—advances have been made recently in the stock market prices of shares in many Canadian metal-mining companies. Long-established and dividend-paying companies such as Teck-Hughes, Lake Shore, Nipissing, Coniagas, and Hollinger, as well as newer enterprises including Noranda, Amulet, and Canadian Lorrain, are included in the list. Canadians and others are asking themselves whether these shares are not over-valued. The answer doubtless varies with the different individual properties; but without attempting to analyze any particular case, certain general observations may be made that apply to the Canadian mining shares as a group. One of the few fairly well written brokers' market reviews asks the question and answers it in the negative. *Inter alia* it says:

"In order to answer this question satisfactorily, several important considerations must be included in the analysis. The basic factors are: proved and indicated ore reserves, demonstrated earning power, financial resources, and current dividend rates. These items, however, would not cover the situation in its entirety. Reasonably assured future possibilities also must be taken into consideration. In considering these possibilities, or *coming events*, our analysis would have to list such items as possible new discoveries, mine expansion, increasing ore reserves, enlarged mill capacity, bigger output, the outlook for more liberal net profits, and the possibility of further increases in the dividend rates. It at once becomes obvious that the mere enumeration of these reasonably assured future possibilities emphasizes their importance in influencing the market valuations for the shares of the mines.

" . . . The persistent advance in the Canadian mines not only reflects present-day intrinsic values, but also is discounting *coming events*. In fact, it is largely this anticipation of coming events that is the motivating influence back of the present major advance in the metal shares. In other words, Canada's mining industry is preparing for bigger achievements in the future. This writer's conclusion, therefore, is that the metal shares are not over-valued, and that a substantial further enhancement in market prices may confidently be expected."

This is a plausible argument. Lake Shore and Hollinger are planning increases in their mill capacity; Teck-Hughes is building an entirely new mill and cyanide plant; Noranda is expanding its large reserves of copper-gold ore each month; Nipissing and Coniagas are developing new properties that may be important sources of income. But in emphasizing so strongly the importance of "coming events" the writer overlooks the *one* event that is absolutely sure to arrive—namely, the exhaustion of the orebodies. Dividends paid by metal-mining companies, speaking broadly, must be large enough to return the capital investment of the purchaser of shares as well as an adequate interest on this investment.

This is not to say that the writer of the excerpt quoted is not correct in the conclusion he reaches. But the point of view must be considered. His real reason for concluding that the shares are not over-valued is that further market enhancement may be expected, not

that the purchaser at present prices can put the shares away and count on getting his money back with interest. That the shares are likely to go still higher and afford an opportunity for present buyers to make a profit, if they are fortunate enough to sell at the top, is not to be denied. This view is purely that of the stock broker and trader.

It is only natural that the shares have climbed, and they probably will climb still higher. Numerous rich and highly profitable mines have been developed; many fortunes, some large and some at least comfortable, have been accumulated from dividends paid by mining companies and from profits made by trading in shares. Those who have not made money know that others have. The sheer momentum of the thing has carried the market price of the shares heavenward.

On the other hand, there is the view of the engineer and mine operator. The managers of several of these mines know, and more than one is willing to admit it, that the intrinsic worth of their mines, taking into account all reasonable expectations of "coming events," is not nearly so great as the present stock-market valuation. There are two answers to the question that captions this editorial: From a purely engineering standpoint the answer is "Yes"; from the standpoint of the market operator, and in recognition of the longing of most of us to speculate, the answer is "Not yet, but ——."

United States of Europe

THE MOVEMENT for a United States of Europe, signalized by the First Pan-European Congress now meeting at Vienna, seems less chimerical now than it would have seemed a year or two ago. There are signs that all Europe is awakening to the self-destructiveness of the policy of mutual hostility and inter-country general economic warfare. The treaty of Locarno, the Continental iron and steel combine, the Franco-German potash cartel, and many other developments have paved a way for a more definite policy of union among European countries. "United we stand, divided we fall" is in effect the cry of those who are promoting the movement. The Manifesto of the Congress states:

> "We joined to make an end to fraternal feuds and economic political hatreds and replace them with peaceful collaboration of free nations. We joined to level European frontiers. To replace wars by arbitration. To arrange customs by European co-operation. To replace suppression by equal rights. This alone will save Europe from political and economic ruin."

While the idea has been suggested that the banding together of Europe is for better competition with America, it is certain that America would look upon such a move with pleasure. Economic prosperity in Europe helps that of America and of the world. Especially the American mining industry needs its former European markets for copper. If the spectacle of the prosperity of a great United States of America has inspired the move toward similar essential breaking down of barriers in Europe, so much the better. The United States itself has something to learn in the matter of economic offenses and defences. The time will come when it will be realized that undue obstacles to trade across natural frontiers stand in the way of world peace and prosperity, as do large standing armies; and that, like armies and navies and other militant institutions, they must be reduced to a minimum, even if they cannot be dispensed with entirely.

Dictatorship of the Engineer

THE ANCIENT MARXIAN PHILOSOPHY, which was embraced and tried out in Russia, was that all wealth proceeds from labor, and therefore that political and economic rule and the chief enjoyment of the fruits of labor should be possessed by those who toiled with their hands. "Only those who have horny hands shall sit at the table" was a Russian expression of this economic philosophy. Hence arose the theory of the rule of the "proletariat," which became the dictatorship of the proletariat when it became evident that the proletariat as a body did not have intelligence enough to rule. Thus there was enforced the expedient of having a small group assume tyrannical power, as trustees for the manual laborers.

The reason why the experiment failed so immediately and colossally was that the philosophy was a hundred years behind the march of events, even in backward Russia. In advanced industrial countries the workman no longer turns out articles of value with his bare hands and crude tools; he simply guides machines—mechanical slaves of mankind they have been picturesquely called—which have been evolved to turn out as much goods under the guidance of one man as a hundred laborers could formerly manufacture. The real producer is hence the mechanical workman of tireless steel, not the human workman who has been displaced. On the theory that the producer should get the reward, the proceeds must go to these machines, or, since they are insensate and slaves, to the producers of these mechanical devices. These producers—the real producers, hence, of goods and of wealth—are the men who have invented, designed, and manufactured them, men whom we class largely as engineers. Should we adopt the Marxian precepts, therefore, and apply them to modern conditions, a dictatorship of the engineers would be logical, and both the capitalist and the manual worker, whose ability is only sufficient to handle, manage, and run these machines and their product, would go into the inferior and (according to the Russian tradition) the oppressed class. Those who sit at the first table should be those who can show hard-worked productive brains, not foolishly calloused hands.

This, no doubt, will be a pleasing picture for engineers to contemplate, while the smoke from the after-dinner pipe curls upward. But in default of the Russian system of slaughter and prison, and because the great mass of workmen, constituting a majority mainly responsible for production, have given way to a relatively small group who are thus mainly responsible, the engineer will have to make good his aspirations, even to a share in the fruits of his labor, in open business competition with capitalist, manual worker, and promoter, all equipped and organized for the battle of wits. He will have to develop his own special trading abilities; and, not content with having set the machinery of production going, he must assume the risks and rewards of assembling the raw materials and marketing the products.

The Oklahoma-Kansas-Missouri Zinc-Lead Field

An Outline of the Geology, Development, and Operating Conditions in the World's Greatest Zinc Area

By Foster S. Naething
Consulting Mining Engineer, Joplin, Mo.

Foster S. Naething

PERHAPS no district so important as the Oklahoma-Kansas-Missouri zinc-lead field, a map of which is shown on the cover of this issue, is so little known and understood by outside engineers. The district during 1925 produced 813,000 tons of zinc concentrates and 120,000 tons of lead concentrates. This was approximately 70 per cent of the zinc production of the United States and 37 per cent of the production of the world. The lead production was about 15 per cent of the production of the United States, the district ranking fourth in that respect. In 1926, about 52,000 tons of ore per working day have been hoisted and milled, which makes the district in point of tonnage the largest non-ferrous producer in the world. About 15,000,000 tons per year is now being mined and milled, and 185 mills, which treated an average of about 350 tons per day, were in operation before the recent slight curtailment took place.

Rapid Development During the Last Ten Years

The present development started with the great demand for zinc during the World War. Shortly after hostilities began, owing to the record zinc and lead prices, the Webb City-Duenweg sheet ground area became very active, and to supply the unusual demand the production was pushed to the utmost. During 1915, 13,000,000 tons of ore was mined, but it was so low-grade and methods of concentration were so imperfect that the concentrate contained only 22 lb. of zinc per ton of ore milled.

Prospecting in Oklahoma had been going on for some years, but there was not a single mill in the present Picher field. The Commerce camp, south of Picher, had been a small producer, but was generally overlooked, and attempts to mine north of this camp had been unsuccessful. The area, however, had been studied by some very capable men, and in 1912 active drilling started. The Commerce Mining & Royalty Co., under the direction of J. L. Robinson and George Coleman, drilled out the Blue Goose property and erected a mill. About the same time Victor Rakowsky, an engineer from the iron ranges, secured leases on 3,000 acres, and, backed by The Eagle-Picher Lead Co., discovered the Netta orebody. Shaft sinking was immediately started, and the attention of the mining men of the district having been attracted to Oklahoma by this and the Blue Goose operation, they started in a wild rush to the new field. Everything was leased and hundreds of drills were started. Orebody after orebody was found, and the mushroom growth which followed, for intensity and speed of development, has seldom been equaled. By 1918, more than 140 mills had been built and the production of the new district was enough to supply the World War demand for zinc. The average grade of ore in Oklahoma was much higher than in any of the other camps in Missouri and Kansas, and in a short time almost every mine in the Joplin-Webb City-Duenweg-Neck City fields was shut down, as they could not compete successfully with the new camp.

Before the entrance of The Eagle-Picher Lead Co. and the Commerce Mining & Royalty Co. into the field, and the sensational success of their operations in Oklahoma had become known, the mines had been owned and operated almost entirely either by individuals or relatively small companies. The practice had always been for the landowners to divide their property into lots as small as 200x200 ft. and to lease these lots to anyone who had a pick and shovel, on a royalty basis. The royalties ran from 10 to 20 per cent of the gross value of the concentrates sold, so the development, mining, and milling were crude and intermittent. Every lease required a separate mill, and it was impossible economically to build anything but the cheapest and smallest plants. At that time the Joplin-Webb City fields probably offered more opportunity for the individual miner to make a stake than did any other district in the country. Now, however, attracted by the very successful operations in the new part of the field, many of the larger mining companies for the first time sent engineers to look over the district seriously, and in a comparatively short time companies like the Federal Mining & Smelting Co., American Metal Co., and National Lead Co. had secured large acreages and became active producers.

Before this, the zinc-smelting companies, although they purchased all the concentrates of this district, had not gone into the mining of the ore. At present, more than one-third of the production is controlled by the zinc-smelting interests, and these, together with the large independent producers, control the greater part of the output. The thirty leading producers turn out about 70 per cent of the total of the district, and the increase in the size of operations and the elimination of the small independent producer are rapidly continuing. The district is the last stand of the small independent miner, but he is being pushed to one side, and it seems that as an important factor his days are limited.

No Good Geological Maps of District Published

Until the U. S. Geological Survey sent Dr. Tangier Smith and Dr. C. E. Siebenthal to make a study of the geology of the old Joplin district, about twenty years ago, no comprehensive study had ever been made of the field. Many engineers and geologists had visited the district, spent a brief time studying the geology, and

then had written theories about the ore deposition. The theories were interesting, but later development and study of the facts showed that in most cases they did not apply. The Joplin folio, published as a result of the study of Dr. Smith and Dr. Siebenthal, unfortunately covered only part of the field and none of the area under the Cherokee shale, from which most of the present production comes.

The U. S. Geological Survey and the Missouri State Geological Survey have followed up the geological work to some extent, but no geological map of the entire district has ever been published and no geological maps are available, to the public, of the areas developed since 1915. Dr. C. E. Siebenthal, in Bulletin 606 of the U. S. Geological Survey, and Buckley and Buehler, of the Missouri State Geological Survey, in their "Report on the Granby Area," have made interesting contributions to the theories of ore deposition, and Dr. Tangier Smith has added some further information. The engineers who have lived in the field have been too busy trying to make the mines pay to work out many theories. Recently, however, there has been a marked change in the study of the mineralization, and companies like the St. Joseph Lead Co., Vinegar Hill Co., and The Eagle-Picher Lead Co. have been making a systematic study of the district and have followed the study by spending millions of dollars in drilling. This drilling has shown many interesting facts, but unfortunately the results are not generally available.

During the last five years I have made a study of the geology, especially in its relation to the finding of orebodies, and have had from twenty-five to fifty drills under my direction during this period. Below I have outlined the main geological factors as I see them:

The ore occurs entirely in the upper part of the Boone formation, which consists of interbedded limestone and flint. There are two horizons of importance in this formation which the engineer in charge of the drilling watches carefully. One is the "Short Creek Oölite," which consists of a thin bed of uniform oölitic limestone, readily recognizable, and the other, from 80 to 120 ft. below, is the "Grand Falls Chert," which is an unusually uniform bed of flint interbedded with the limestone. Both formations are in places missing, especially in the Oklahoma field. The important orebodies occur in the zone from 50 ft. above the oölite to a short distance below the bottom of the "Grand Falls Chert." The above horizon, which is from 150 to 200 ft. thick, is the one which should be prospected, and consequently it is important to recognize the formations in order to know how deep the drilling should be carried.

The Boone formation has undergone a distinct though slight warping or folding, as is shown in the Joplin folio, and it was believed by many that the orebodies were intimately related to the folding. The recent drilling, especially of the St. Joseph Lead Co., in Kansas, shows that the overlying Cherokee shale is extraordinarily free from any folds, extending for miles with a uniform dip to the northwest of about 15 ft. to the mile, and consequently the folding of the Boone must have occurred before the Cherokee shale (Pennsylvanian) was laid down. In view of the probability that the present orebodies were formed after the Pennsylvanian, it is rather difficult to see a very intimate association between Pre-Pennsylvanian folding and the orebodies, excepting that some of the Pre-Pennsylvanian folds may have been zones of weakness which controlled subsequent fracturing.

Some writers have connected the orebodies with faulting, but the district is conspicuously free from faults. The Seneca fault, shown on the map, consist of a block of Boone dropped vertically between two faults. Its relation to the orebodies is rather uncertain, as the mines developed near it have all been relatively unimportant. The Miami fault appears to be an old Pre-Chester erosion channel, possibly controlled by Pre-Chester faulting, which was subsequently a line of weakness, and a small amount of faulting, not to exceed 50 ft., may have occurred along it since Pennsylvanian deposition. In the Picher field this fault runs through the district, but its relation to the orebodies is uncertain, except that on account of the fracturing it has been in some parts a favorable place for ore deposition.

The fracturing since Pennsylvanian times of the flint zones and beds seems to be the most important geologic feature to study in the search for orebodies. Any ore which is found in the limestone is looked upon with great suspicion by the local operators, as it is very pockety, whereas the ore in the flint zones, which are always fractured, generally is quite persistent.

Ore Near Pockets of Shale

All of the orebodies occur either under or comparatively close to pockets or channels of subnormal shale. The relation between the subnormal shale and the ore has long been noticed by prospectors and engineers, and twenty years ago J. R. Finlay, in his "Costs of Mining," and Buckley and Buehler, in their "Report on the Granby Area," bring out the relationship of the mineralization to the "soapstone bars," which is the local name for the pockets or channels of subnormal shale. In recent years the subnormal areas of shale have been traced through shallow drilling by some of the companies and interesting relations to the orebodies worked out. It seems that the subnormal shale has been caused either by the filling, during Pennsylvanian times, of sink holes and erosion channels which were formed during post-Boone or post-Chester erosion, or by the dissolving out of the underlying limestone by underground solutions after the shale was laid down and the subsequent slumpage of the overlying shale. This last process is still taking place, as is shown by the caving in of the shale and the formation of sink holes, which occurs rather frequently. Probably the limestone, along the edges of the old erosion channels and sink holes filled with mud and shale, was fractured by minor earth movements, and water circulating through the fractured zones then dissolved out part of the limestone and replaced the remainder with flint. This caused slumpage of the overlying shale and in some places greatly increased the area and depth of the subnormal shale.

The orebodies occur generally as runs which can be likened to very irregular river channels, but also in places as regular beds in the "Grand Falls Chert" and in every conceivable shape in pockets in the upper part of the mineralized horizon. The ore consists of sphalerite and galena, which are always associated with either jasperoid or dolomite, or both. All four minerals for which the district is noted undoubtedly were deposited contemporaneously. Microscopic studies of ore sections by Dr. Tangier Smith seem to show that the mineralization was a replacement of the limestone which in some instances had flowed between the brecciated flint. In prospecting, the occurrence of jasperoid and

dolomite is watched carefully, on account of their intimate relation to the zinc and lead.

Deposition seems to be zonal in two ways. The upper or outside part of the orebodies generally contains more lead than the bottom or center of the orebodies, and the mines near or under the east margin of the Cherokee shale seem uniformly to be richer than the mines to the east in Missouri. There are many exceptions to this in individual orebodies, but looked at from a broad viewpoint this condition seems to hold true.

Drilling and development have failed to show fracturing more than a short distance below the "Grand Falls Chert," and a drill hole, after having gone through possibly as much as 200 ft. of fractured flint, always goes into tight unaltered limestone and chert. No igneous rocks have ever been found, nor any mineralized veins. The underlying granite is from 1,000 to 1,500 ft. below the present surface.

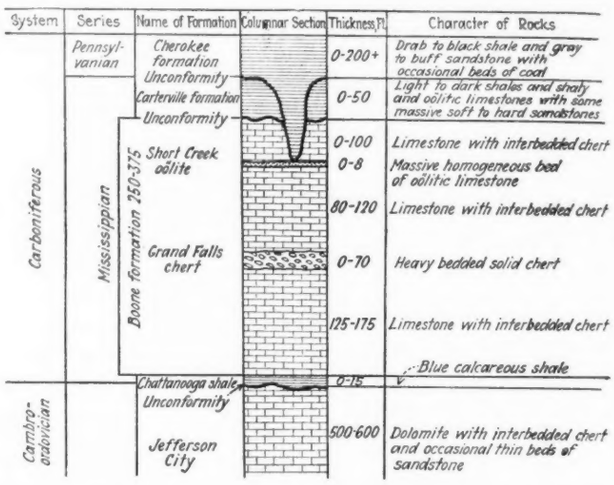
I believe that practically every engineer or geologist who has attempted to find ore in the district holds the view that the ore was deposited by cold meteoric solutions which migrated either downwardly, laterally, or in an artesian circulation, from areas of oxidation where the lead and zinc were dissolved from sedimentary rocks into a zone of reducing conditions where the ores were deposited. Possibly all three movements of the solutions occurred. When the mines of the Oklahoma field were first opened up, free hydrogen sulphide gas in the water was strong, sometimes affecting the eyes of the miners, and positive reducing conditions were evident below the shale. The relation of the orebodies to the fractured flint areas may have been caused by the solutions following the open channels, and only in them did the chemical reactions take place which precipitated the ore.

Development of the District

Before 1890, all of the prospecting was done by the sinking of pits and shafts wherever a prospector fancied. It was easy to obtain a small lease, and if a prospect were found, it was not difficult to get a small group to back the building of a mill, which seldom cost over $15,000. Early prospecting was done almost entirely in Missouri and considerable skill was shown in finding the ore. It was recognized that all through the district were unfractured lime bars which were not mineralized. "Soap bars," which consisted of channels or pockets of Cherokee shale, on the other hand, were recognized as being extremely favorable places to prospect, and on account of the comparative softness of the shale and the hardness of the limestone the last-named mineral was generally found under a hill and the shale in the valleys or depressions. It was impossible to do any prospecting by shallow shafts in the area in Kansas and Oklahoma, this being entirely overlain by shale, and the flow of water under the shale was always heavy. Practically no maps were kept by the early prospectors, and the total output of the district before 1890, although there were hundreds of operators, was small.

About 1890 the churn drill was introduced for prospecting, the results obtained being more satisfactory than by the old method of sinking shafts. The sheet ground in the Webb City-Duenweg area, consisting of a uniform mineralization in the "Grand Falls Chert," was soon after opened up and the scale of the operations greatly increased. Drilling, however, except in a few instances, was rather haphazard, and no assays were made of the cuttings. Logs were made by the drillers, who varied greatly in their interpretation of the formation drilled through, and few maps were made. Almost no reliable records now exist of the great amount of drilling and prospecting which was done in Missouri before 1910.

In 1915, in the drilling in Oklahoma of 3,000 acres of leases for The Eagle-Picher Lead Co., Victor Rakowsky



Relation and age of the formations found in the Missouri-Oklahoma-Kansas zinc-lead district

drilled sections across the major trend of the mineralization, so as to pick up the runs of ore; pasted samples of each 5-ft. run on a card, 1 in. of which represented a 5-ft. sample; assayed all cuttings which showed commercial mineralization; and mapped the work accurately. This was probably the first really systematic work done in recording the drilling, and the results were very satisfactory.

In 1921, extensive shale drilling was first introduced by the engineers of the St. Joseph Lead Co. This consisted in drilling shallow holes which penetrated only a few feet into the solid Boone formation. The holes were drilled in sections, sometimes quite far apart, and if a lease showed favorable formation it would be checkerboarded with shale holes 200 to 400 ft. apart. This method of drilling has been successful not so much in directly locating orebodies but in outlining the unfractured lime bars and showing where not to drill.

Shale holes can be contracted for at from 40c. to 60c. per foot and deep holes at from 90c. to $1.25 per foot, depending on the character of ground drilled through. Between 300 and 500 drills were in operation recently, the operations now being controlled almost entirely by engineers.

Mining Methods Are Unique

Conditions in the field are so different from those in any other that many unusual methods have developed which, when first studied, seem uneconomical. Probably the most important difference from other districts is that in the past almost all of the ore was mined from small tracts, each one under a separate lease and usually requiring a separate mill. The leases were generally of comparative short life and required continuous work. On account of these conditions the life of a single mining operation was short, and the capital expense had to be kept down.

The standard shaft is 5 x 7 ft. in the clear, and through soft ground is cribbed by 2 x 6-in. boards. Most of the shafts are less than 300 ft. deep, the deepest shaft in the district being only 360 ft. deep. Below the loose surface formation, most of the mines require no timbering. The ore is mined, except in the relatively unimportant soft-ground deposits of Missouri, with a regular room-and-pillar system. The government in tax valuations insists on allowing 15 per cent of the ore as pillars, but actual mining results show that probably less than one-half of this figure is more nearly correct. The average ore run is about 15 ft. high, but sometimes is as high as 60 ft.

The ore is shoveled into cans which hold about one-half ton. The cans stand on trucks and are trammed over 8- or 12-lb. rails. Mules have been used for many years except for short trams, and recently small electric locomotives have been introduced in several mines with success. Shoveling is done either off boards or iron sheets by men using "Joplin scoops"—short-handled scoop shovels. Men average around 50 cans, or 25 tons, per shift. The cans are generally paid for by contract at so much per can. I believe the tonnage shoveled per man is better than that in any other district, and it seems that this is because a man can handle more with a "scoop" than with any other shovel and also because the quality of labor is far above the average of other districts. There are no unions and never have been. The men are Americans, intelligent and efficient. A sliding scale of wages, depending on the price of zinc concentrates, is paid, and the labor turnover is small. Miners and the management co-operate to an unusual degree in the study of mining problems, and recent co-operative safety and sanitation work has been most satisfactory.

The hoisting is unique because of the extreme speed in the shallow shafts and the fact that there are no guides in the shaft and no signals are used. A can is hooked on by the "tub hooker" at the bottom of the shaft, and then hoisted by either small electric, steam, or air hoists with a rope speed of from 1,500 to 2,000 ft. per minute, to a point slightly above the hoistman's head. The hoistman then attaches a hook to a ring in the bottom of the can and lowers the can, which dumps into the ore bin. To do this, the hoist is directly over the shaft in a derrick about 50 ft. high. From a depth of 300 ft. it is common practice to make a round trip every thirty seconds, the dumping taking only about ten seconds. The hoistman keeps his hand on the cable when the can is at the bottom of the shaft and can feel the impact of the bale of the full can when it is hooked on. He then throws in the clutch and hoists the can at maximum speed, the drum of the hoist being run at full speed during the entire operation. The hoisting is done so rapidly that the can has no chance to swing and the whole operation is remarkably efficient. The men all ride up and down in the cans, generally four to a trip, and the shafts have no ladders.

In the next column are cost figures compiled by the Tri-State Lead and Zinc Ore Producers' Association for the twelve months ended Nov. 30, 1925.

In 1910 the mills in Missouri, except from the soft ground where the ore was free and easy to mill, saved only about 60 per cent of the zinc content. Milling cost per ton was very low. In the Oklahoma field part of the ore is intimately associated with jasperoid, part of it being disseminated in comparatively fine crystals.

Cost of Mining

	Cost per Ton Ore Hoisted	Per Cent of Operating Cost	Cost per Ton of Concentrates	Per Cent of Total Cost
Labor	$1.000	47.58	$15.38	32.9
Supplies	0.387	18.41	5.95	12.7
Liability insurance and accident prevention expense	.065	3.07	.99	2.1
Explosives	.183	8.69	2.81	6.0
Exploration and development	.109	5.18	1.67	3.6
Power, all classes (fuel and electricity) consumed	.168	8.01	2.59	5.5
Fire and tornado insurance	.020	0.97	.32	0.7
Management and office salaries and expense	.080	3.81	1.23	2.6
Taxes (including federal income tax)	.022	1.02	.33	0.7
Miscellaneous	.068	3.26	1.05	2.3
Total operating cost	$2.102	100.00	$32.32	69.1
Amortization of capital, cost of:				
(a) Land, leases, development of mine, etc	.....	3.81	.....	....
(b) Plant and equipment (depreciation)	.....	2.56	.....	....
Total	.....	.....	6.37	13.6
Royalty	.....	.....	8.07	17.3
Total cost of production	.....	.....	$46.76	100.00

Average percentage of concentration, 6.502 per cent.
Tons ore hoisted per man per day, 4.827 (based on total men employed in mine, mill, and miscellaneous surface labor).
Tons of concentrates produced per man per day, 0.3214.

This has required better milling methods than in the old Missouri district, and since 1923, when the engineers of the U. S. Bureau of Mines started to make comprehensive milling tests, considerable progress has been made. Introduction of automatic cones and drag classifiers has greatly decreased the loss in slime in jigging. The speed of the jig has been increased to from 80 strokes per minute to about 120, resulting in greater capacity per jig. Slotted pipes, which draw off middling from the bed, have been generally introduced, making it possible to draw off a comparatively low-grade product, which is crushed and rejigged. This has decreased the tailing losses considerably. Probably the most important improvement has been the introduction of flotation and filters in some of the mills, with selective flotation of the lead. The introduction of filters has made it possible to save the float concentrate and put it in the bins in a form acceptable to the smelters. Recently the introduction of ball mills to regrind the rich fine middling from the cleaner jig or tables has been successful. Practically all of the zinc sulphide is freed at 40 mesh, and the slow-speed rolls used will not grind much finer than 2 mm. As a result of the improvements mentioned the best mills in the Oklahoma fields now recover about 80 per cent of the zinc, and in the soft ground area of North Joplin several mills are now recovering about 95 per cent of the zinc and lead. The lead always occurs in large crystals free from the other minerals and is easy to save.

The concentrates, which average nearly 60 per cent zinc or 80 per cent lead, are sold on Saturdays to the highest bidder. They are paid for in the bins, and generally 80 per cent of their value is advanced when the sale is made. The selling is carried on by telephone; no letters of confirmation are sent by either buyer or seller, and it is to the great credit of the sellers, buyers, and the telephone company that $60,000,000 worth of concentrates are now being sold each year with complete freedom from misunderstanding.

From time to time it is reported that the district has only a short life, but recent developments do not seem to bear this out. The district, which covers more than 1,000 square miles, seems in a general way to have been limited both as to area and depth. All of the commercial mineralization found has been in the zone from

50 ft. above the oölite to 100 ft. below the "Grand Falls Chert," and all attempts to find commercial deposits above or below this zone, although many thousands of holes have been drilled, have been negative. On the east, the district is apparently limited by the outcrop of the "Grand Falls Chert" thinning out to a few feet; and on the Chattanooga shale, south of which there does not seem to be any mineralization of importance; on the north, by an irregular line possibly controlled by the Grand Falls Chert thinning out to a few feet; and on the west, by a line some miles west of the Eastern edge of the Cherokee shale. This last line has not been accurately determined, but the drilling of the St. Joseph Lead Co. on 70,000 acres in Kansas shows that west of a certain line no jasperoid, dolomite, sphalerite, or galena was found, although fractured flint zones occurred. West of Picher the limit of the mineralization has not been found, and it seems possible that a new area may be opened up a few miles west of the present mines.

The great improvements in milling have resulted in over 100,000 tons of concentrates being saved per year which were formerly lost, and the improvements in milling should continue.

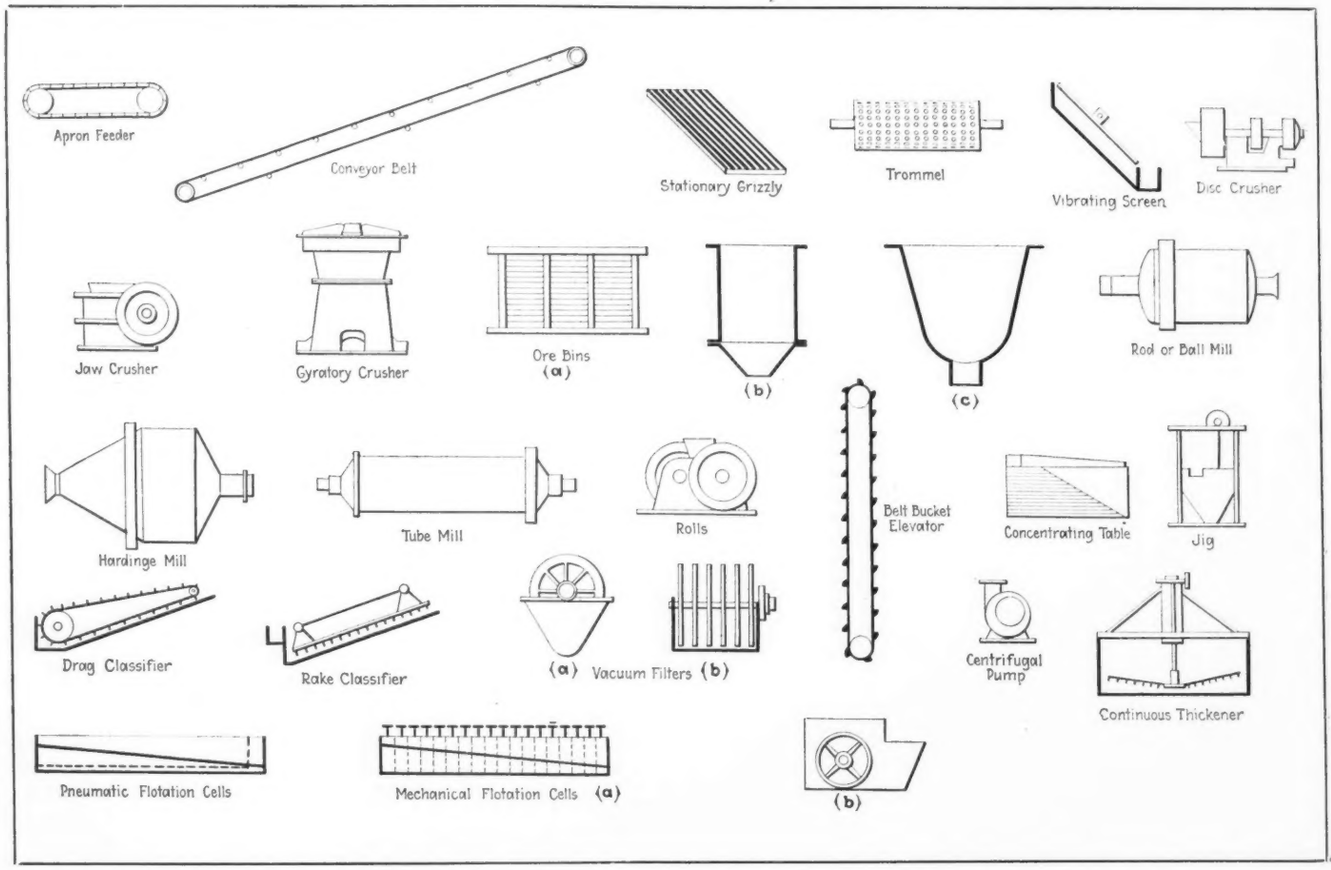
The only great loss which still occurs, with no material improvement in years, is in smelting, as the retort smelters recover only about 85 per cent of the zinc and the cost of smelting per ton of concentrate is high. The practice has shown no radical improvement for the last hundred years. It does not seem possible that the great losses and present costly methods can continue much longer, and better methods will probably be developed, which will make the spread between the value of zinc in concentrates and as metal much less. If this takes place, much lower-grade ore can be mined and large tonnages now valueless would be profitable.

The trend is undoubtedly toward larger acreages under one operation, with larger mills and larger companies, which are much more able to carry on during periods of depression.

Improvements in the methods of prospecting have resulted, during the last few years, in developing ore faster than it has been mined, and I believe the district now has more ore actually developed than ever before. As a result, instead of the production decreasing it has recently been necessary for many of the mills to shut down because of limited concentrate consumption.

The future of the district is bright, and it certainly can be counted on to supply zinc for the needs of industry for many years.

Symbols for Mill Flow Sheets



THE making of flow sheets showing the operation of a mill or concentrator is not an easy task. Various methods are used, but the most easily read flow sheet is one in which the symbols used have some likeness to the machines or equipment that they represent. At the same time simplicity is desirable or the work of the draftsman becomes excessive. The symbols shown above have been devised for the use of the artists in the drafting room of the *Engineering and Mining Journal*. Several large prints have been made in which the symbols are the proper size to be traced on the drawing of the flow sheet. The editor merely blocks out a rough sketch and the draftsman traces the necessary symbols and connects them with the appropriate arrows and lines showing the flow. Some of the symbols doubtless could be improved, but the idea has been found to save time.

Repair and Maintenance Work at Magna Mill

Utah Copper Co. Has Well Organized Mechanical Force—Handling of Rolls, Crushers, and Screens by Traveling Cranes—Design of Wearing Parts Reduces Frequency of Replacements

By George J. Young
Associate Editor, San Francisco, Calif.

THE MAGNA MILL of the Utah Copper Co., at Garfield, Utah, was first put in operation in 1907. At that time the capacity was 6,000 tons per day and the treatment plan involved gravity concentration. Numerous changes have been made, the most important being the reconstruction of the coarse-crushing plant in 1923 and the adoption of an all-flotation treatment subsequently. The capacity is now 24,000 tons, but the plant is operated at about 21,000 tons per day. Such changes as have been made are in the direction of simplification of design and of ore treatment.

The present treatment scheme involves coarse crushing in gyratories and rolls to ⅝ in. and fine crushing in rolls and ball mills to 5 per cent on a 65-mesh screen. The final product is the overflow from rake-type classifiers, and this is treated in alkaline circuit by flotation machines of the Janney type. The flotation froth is thickened and finally dewatered on disk filters and the concentrates are shipped to the Garfield smelter.

Estimated quantities involved in the treatment of 21,000 tons per day are 1,000 lb. potassium xanthate, 2,200 lb. pine oil, 55 tons of lime, 20 tons of steel and iron, 436,000 kw.-hr. of power, and 600 shifts of labor. The product is about 1,000 tons of concentrate containing about 175 tons of copper, with accessory gold and silver. The average copper content of the ore is 1 per cent and the recovery about 87 per cent, the milling cost in 1925 being $0.436 per ton. On the basis of this milling cost, the per-day operating cost is $11,300, or a per-hour rate of about $470. A decrease of 1,000 tons per day in mill capacity increases the direct milling costs approximately 1.5c. per ton. A decrease of 1 per cent in copper recovery involves copper to the amount of 4,200 lb. and a loss of over $600 per day.

It is evident that the management of a huge plant of this kind involves peculiar difficulties in that the losses caused by slight discrepancies in treatment, by carelessness, or by failure of any element may amount to large sums, and unless quickly discovered and eradicated these become cumulative. Therefore, a close co-ordination of all features having to do with milling operations as well as an adequate supervision and control are vital requirements.

Utah Copper operates two large milling plants, and one thus becomes the counterfoil of the other. Both plants are symmetrically divided into two large parts, each subdivided into a number of sections. As a result it is possible to compare operations within each mill and to compare each with the other. The operating organizations are in a sense competitive. Changes in equipment are predicated on the results of experimental runs of considerable duration. The effect of every general improvement is therefore known.

Operating Organization

The organization consists of a superintendent, E. W. Engelmann, who is in direct charge of all activities, and various departments—metallurgical control, operation, repair, maintenance and construction, stores, salvage, and accounting. The repair and maintenance department, the subject of this article, is divided into three divisions: machine, plate, and forge and tin shops, in charge of a master mechanic, C. B. Duckworth; electrical repairs, in charge of the chief electrician, H. E. Wurzbach; carpenter shop and woodwork, in charge of the general foreman carpenter, P. R. Shultz. New construction work is divided among the three departments in accordance with the nature of the work. Preparation of working drawings is in charge of B. E. Mix, chief draftsman, and the engineering department at Arthur.

The coarse-crushing department consists of two parallel units, either of which can be operated independently of the other with the exception of the No. 27 gyratory crusher, which is the only machine not in duplicate. Fine-crushing and flotation divisions are

Machine-shop building, housing also the sheet-metal and plate shop and storage yard for large castings

divided into parallel sections, any one of which can be shut down without interference with other sections. Dewatering, filtration, and accessories are so arranged that all or part can be operated. Enough storage in fine bins is provided for three shifts' operation, so that delays in ore receipts or in the coarse-crushing department do not interfere with regular operation of fine-crushing and flotation divisions. Two-shift operation of the coarse-crushing plant will supply sufficient ore for continuous operation of the fine-crushing and flotation divisions. Consequently, one shift is available for extensive repairs in the coarse-crushing division. Allowing for fine storage, a maximum of four shifts down can be allowed, for receiving and coarse crushing, before the fine-crushing division would be down through lack of ore. Only an extraordinary condition would thus curtail capacity to a serious extent.

Permanent Construction in Steel and Concrete

Permanent construction is of steel and concrete, thus requiring a minimum of maintenance. New construction is designed and installed to avoid frequent replacements and to give the longest wear. All gyratory crushers are protected from breakage by flexible couplings interposed between direct-driving motor and crusher. These by shearing stop the crusher and prevent damage by tramp iron. An overload relay is an additional safeguard on motors. Materials and supplies are stocked in sufficient amount to minimize delays. Shops and shop equipment are such as to enable practically all normal repairs to be made at the plant. A sufficient organization is maintained to do this rapidly and economically. To employ the working force fully a certain proportion of parts and accessories are manufactured. At the Arthur plant, brass and iron foundries are operated and small and large castings in great variety are made for both plants. In addition, a ball-casting machine is operated which supplies all balls required in both plants. This enables scrap iron and steel to be utilized and is an important economy. A salvage department is maintained. Parts are retrieved and scrap metal is classified, and such as is suitable for foundry work used.

The use of direct drives and speed reducers has cut down the number of belt drives to a minimum. All rolls are driven from countershafts and are the only important belt-driven units remaining. Tex rope drives have been introduced and are favored for conveyors. Bucket elevators are driven by gear sets except where replacements are yet to be made. Conveyor and bucket-elevator belting and roll-drive belting represent the important applications. All other drives are by gears. This is in line with the gradual use of direct, speed reducer and gear case drives that has characterized milling practice in recent years. A higher degree of safe operation has thereby been obtained as well as an appreciable economy in replacements and a saving in delays.

The important regular repair work consists of the replacement of wearing parts in gyratories, rolls, screens, feeders, ball mills, and flotation machines and the rebabbitting of the bearings of these machines when worn. In addition, there is the replacement of conveyor and bucket-elevator belts, buckets, and transmission machinery maintenance.

Daily repair work is segregated in different parts of the plant. The general arrangement consists of moving parts to the end of the particular bay in which the machines are in operation. Thus, at the No. 27 gyratory and the car dumpers, a 60-ton crane with 15-ton auxiliary hoist serves the heavy equipment and there is sufficient room for handling the parts. On the hopper floor of the crusher an extra shaft and mantle is kept in readiness. At the four No. 9 gyratories, used for intermediate crushing, the hopper floor is used for repairs. This is served by a 30-ton crane. A 2-ton crane serves the screen bay of the coarse-crushing unit. At the ends of the primary roll section are two repair bays, where roll shells are replaced. A 30-ton crane serves the entire bay. In the fine-crushing division the fine-roll bay is prolonged and affords sufficient area for roll shell replacements, babbitting shop, and concrete mixer. This is served by two 15-ton cranes. The ball-mill division is likewise extended to provide a repair floor, which is served by a 50-ton crane. The flotation division is extended out to one side to provide a repair floor, which is served by five light crane runs extending over as many separate bays containing the flotation cells.

Practically all parts requiring replacements are handled by traveling cranes and nothing is lifted or handled by hand. Repair crews work in their respective divisions, so that little time is lost. A worn-out ball mill is picked up by the crane and transferred to the repair bay and a relined mill is ready to be picked up and replaced in the stand. Likewise, worn-out rolls are removed and replaced by others with a minimum loss of time.

Unloaders and Crushers

The car unloaders of the Wellman, Seaver, Morgan type have been hung up for repairs twice in two and a half years, the longest delay being seven hours. Buffers on the unloader have been relined after an eighteen months' run. Comparatively minor repairs have been necessary. On the large crusher the concaves have not been changed. Changing the shaft required eight hours. It is estimated that from fourteen to eighteen hours would be required to change the manganese steel mantle and concaves. The four No. 9 gyratories, crushing from 6 to 2½ in., are down once a month at different times. It takes eight hours for the heaviest repair and a few minutes for repair work on the individual grizzlies above the hoppers of the gyratories. New apron feeders have been installed below the surge bin of the gyratories. These are now operated by Tex rope drives and require only nominal repairs. As feeders are in pairs, a single feeder can be cut out and a bypass used when repairs are necessary.

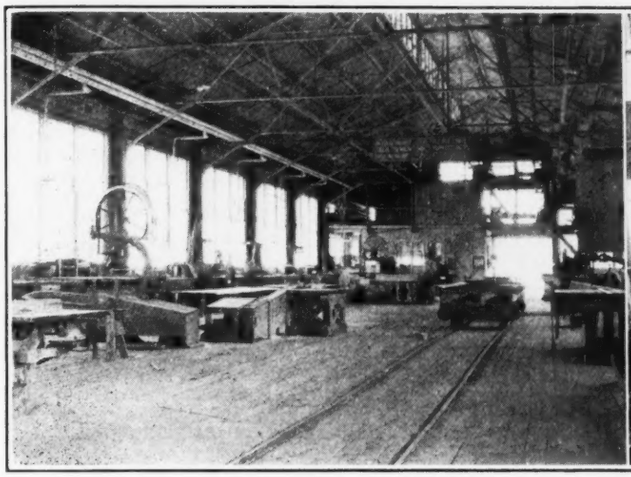
There are twenty-six conveyor belts in practically continuous operation in the coarse-crushing plant. Belts on the 54-in. conveyors last three years. By the use of welding, repairs on troughing idlers have been minimized. By turning conveyor belts additional service up to 120 days is obtained before the conveyor belt is discarded. Experiments are being tried out on duplex conveyor belts. Discarded conveyor belts are used for different purposes. Weightometers, of which there are two on the 54-in. conveyors, require no repairs and sample cutters on the final product need only nominal attention.

It is of interest to note that no magnets are in use and tramp iron is picked out by hand. Shovel teeth

occasionally get into the No. 9 gyratories and larger iron is stopped in the large gyratory. More or less trouble was experienced by coupling pins which fell out when the cars were dumped, but by the use of cotter pins the difficulty was removed. The flexible couplings on all gyratories have effectually obviated damage. Push-button controls are placed along the conveyor system and solenoid brakes on all inclined conveyors.

Crushing Rolls Give Maximum Service

Two sizes of rolls are in use in the fine-crushing division, 42 by 16; and 37½ by 15 in. Roll shells are



Interior of wood working shop

Roll repair bay in fine-grinding division

4¾ in. on the 42 in. and 4½ in. in thickness on the 37-in. rolls. The present plans are to throw as much as possible of the work of crushing upon the rolls, as roll steel is one-half the cost of ball-mill steel. Three dry rolls driven by a 450-hp. motor are to be used on each section. A heavy choke feed is used on rolls, the feed being maintained just level with the cheek plates, reduction being from ⅝ in. down to 12-mesh size. No friction clutches are used on countershafts or in other parts of the mill. Cast-iron pulleys on countershafts are being replaced by boiler-plate pulleys, which are constructed of a steel web welded to rims. The pulley is a split pulley. Trouble was experienced by heating of the cast-iron pulleys due to belt slippage. The resulting expansion wrecked the pulley. Split pulleys are used on the 72-in. rolls. All belts are put on pulleys by the use of the traveling crane.

The average life of 37-in. roll shells is 55 days; 42-in. shells, 60 to 62 days; 54 by 20, 80 days, and 72 by 20, 120 days. Shells are worn down from ½ to ⅝ in. before removal. Nickel-steel roll shafts last from seven to eight years. Roll shells, cheek plates, and bearings involve the greatest frequency of replacement. Replacement of roll shells has been standardized. An oil-fired furnace, using distillate, is employed for heating the roll shell, which is placed on the roll and the roll swung into the furnace. The shell is expanded about 1/16 in.; the roll is removed from the furnace, and the follower plates are battered into position with a ram. About an hour is required for the job. When bearings wear out, the remaining babbitt is melted and the bearings rebabbitted. A sufficient number of rolls with accompanying bearings are kept in reserve to make immediate replacements.

Thirty-six ball mills are operated continuously, two ball mills being kept in reserve for replacements. Each mill is driven by a 150-hp. motor, through a flexible coupling and gear case. The large gear wheel runs five or six years and is then turned over and additional life secured. Supplementary gears last about four years. The ball mill is equipped with two single-piece end liners and three single-piece cylindrical liners, all of white iron cast at the Arthur foundry. End liners and cylindrical liners have been so designed that they are locked in position. The mill is in two halves bolted at the middle line. End liners are thickened so as to throw the balls away from the trunnion liner. The cylindrical liners are cushioned by an outer lining of old bucket-elevator belting from ½ to 1 in. in thickness.

In tearing down a mill, the two heads are first removed, the sections unbolted and the top half removed. The worn liners are removed from the shell and elevator belting is replaced, new liners are placed in position, and the top half is replaced. Three men reline a mill in sixteen hours, which includes removal and return to place. Ball mills are inspected at the end of the first six months and then at nine months. From eighteen to twenty months' service is obtained from liners, which are retained until a single liner in a mill holes through or gets dangerously thin. Inspection is made by entrance through the trunnion opening, which is 13 in. in diameter.

Feed scoops are cast of soft gray iron and are machined on one side. The inner cylindrical part is provided with ribs which form narrow pockets that become charged with ore and in part take up wear. The feed liner in the trunnion is provided with a spiral to convey the balls into the mill. The discharge end liner has a steel nose-piece with cast internal spirals protected by strips of old conveyor belting bolted on. These operate to prevent the balls from discharging. Some of the rubber belting protection has been in place for three years.

The ball mill weighs twenty-five tons. It is handled by a pair of 1¾-in. wire-rope slings. The lugs provided for handling the mill are not used, slings being placed about the cylinder of the mill.

Bucket Elevators

Bucket elevators in constant use total 45, of which 36 are in the fine-crushing division, 8 on the dewaterers, and 1 outside of the mill. Belts are 36 in. wide and

Yards and shops are served by locomotive cranes which operate on standard gage tracks

buckets on wet elevators 18 by 9 by 8 in.; on dry elevators, 18 by 8 by 8 in., with reinforced lips, the other buckets being plain and all of malleable iron. Buckets on dry elevators are changed every six months, but those on the wet elevators have been in use over a year. The alkaline or lime circuit is responsible for a great reduction in general corrosion of all iron parts in contact with wet pulps and has also reduced wet bucket elevator replacements. A lime scale builds up in the buckets to a thickness of ½ in., and this serves to protect them from wear. Wet elevator belts give better than 1,000 days' service and on dry elevators average 750 to 800 days. Head pulleys are good for three years and are then taken off, recrowned, and returned for two years' more service, or a total of five years. Head-pulley shafts have been increased in size until they are now 8 in. in diameter. Boot pulleys on dry elevators wear out in two and one-half years and are bushed generally every six months. On wet elevators after two and one-half years' service the boot pulleys are rebushed every eight to ten months. Take-up mechanisms last indefinitely.

Bucket elevator belts are laced with a bronze splice plate bolted in place. This is 12 in. wide by half the width of the belt. On conveyor belts "high-duty" fasteners are used on belts ¾ in. or over in thickness, and below ¾ in. in thickness, Talcott fasteners are used.

Rake-type classifiers are relatively free from repairs, as the boxes are of reinforced concrete and the change from acid to alkaline circuit has reduced corrosion to a minimum. Rakes last about two years.

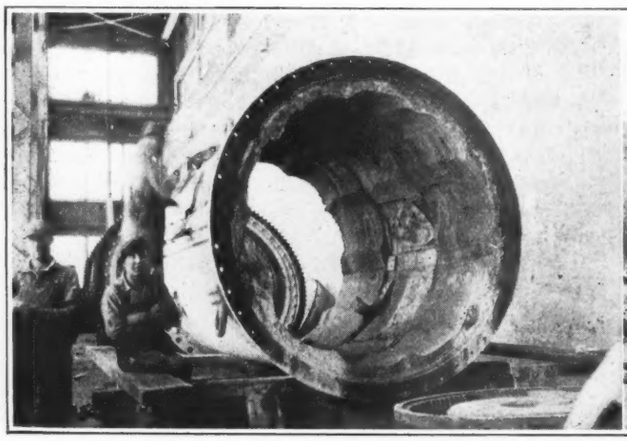
Flotation Machines

On flotation machines repairs are restricted to replacement of runners and the cloth on the air mats. Bearing and motor troubles are only occasional. White-iron runners last 200 days and rubber 600 days. Apparently a greater use is now being made of white-iron runners. Air mats last 110 days before repairs. The cloth on the cells lasts 180 days and iron straps last three years. In all, 660 cells are in operation, in which there are 1,320 mats. Tailings from cleaner cells are pumped by 6-in. Worthingtons and Wilfleys to the discharges of the rake classifiers. Six pumps are placed at each end of the mill for this service, and two in each bank are in continuous operation. Filters require few repairs, as the 2-in. redwood sectors last indefinitely and filter cloths average sixty per month on 30,000 tons of concentrates. Wooden rollers developed at this plant last two and one-half to three years.

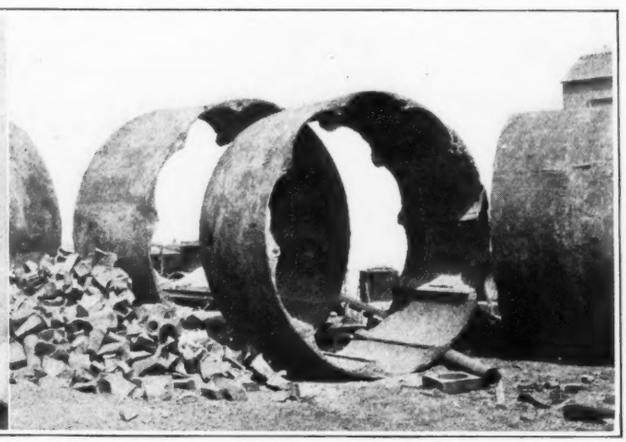
Electrical Repairs

The maintenance of electrical machinery and accessories is an important part of the work of the repair division, as 1,348 motors ranging from ⅛ to 850 hp. are in practically continuous operation, only two days' shutdown being allowed for the year. The majority of these motors are of the squirrel-cage induction type. A few motors are of the variable-speed type, and direct-current motors are used only on cranes and machine-shop tools.

Trouble has been experienced with the lower bearing of the vertical motors, of which there are 720. This has been eliminated by redesign and the provision of suitable channels for balancing air pressure. With the original type of bearing, a variable water level in the flotation cells resulted in a partial vacuum under certain conditions. The vacuum thus formed drew the lubricating oil out of the oil cavities. Part of the flotation motors (vertical) are equipped with ball bearings, and these have given satisfactory service, but are not considered as good as the roller bearings, on account of the difficulty of lubrication.



Ball mill in process of stripping for new liners

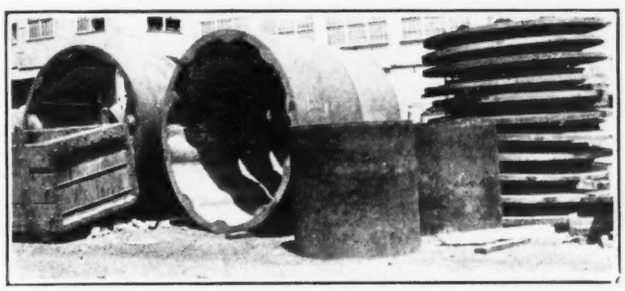


Worn ball-mill liners. Note single-piece construction

In dusty places motor bearings are protected by keeping them tight and by the use of felt washers. Oil is removed and bearings are cleaned every sixty days. Used oil is filtered on a gravity filter and re-used in places where a lower-grade oil is appropriate. Grease lubrication of horizontal roller bearings and oil on vertical bearings represent the trend of motor lubrication practice in the mill.

Motors are protected by "current overload" relays, no fuses being used. On the smaller motors and also on some of the larger ones a temperature relay has been adopted, but it has not proved to be satisfactory except when used in conjunction with current transformers. Half of the motors carry full load and 10 per cent carry from 10 to 15 per cent overload continuously, thus maintaining a power factor of 80 per cent. Ten 275-hp. synchronous motors and one 500-hp. synchronous motor on the blowers are also a factor in maintaining the power factor.

No starting equipment is used, as all of the motors



End and cylindrical ball-mill liners in yard storage

are started on the line. The use of compensators has been discontinued and magnetic cross-line contactors with push-button controls have been adopted as standard. The advantage of the contactors is in lower cost of maintenance and increased flexibility of the system. Certain drives are grouped, so that if one motor stops all others back of it automatically stop. This arrangement is on the conveyor system in the coarse-crushing plant.

New wiring and most of the old wiring is in conduit and is installed as permanently as possible. All yard wiring and power cables are in underground conduits. A standard steel junction box, made in four sizes, is in general use. All switches and contactors are made in the shops, as are also all motor repairs. Coils are made in the shop, double cotton-covered enameled wire having been found most suitable for the motor coils, especially where motors cannot be wholly protected from water. The average life of motor windings is close to five years. The flotation motors have been in use for three years and it is expected that the windings will last about eight years. Motors are not tested unless they show trouble. Motors driving the fine-crushing rolls are provided with load meters.

The electrical repair shop is equipped with an electrically heated oven for baking insulation. This is auto-controlled at 125 deg. C. In addition there are the usual bench tool accessories, a Seger tapping machine for winding small coils; a "hairpin" coil winder for larger coils; lathe; acetylene welding outfit; emery wheels; and miscellaneous small tools. A repair crew of twenty-five men is maintained on the day shift for repairs and light construction.

The mill is segregated into three zones—coarse crushing, fine crushing, and flotation. Two trouble men are on each shift, each being responsible for half the mill. In addition there are six men, each having a specific part of the mill in his charge. One man is on each shift in the central transformer station. The electrical repair department has charge of seven miles of steel tower transmission line, which is patrolled twice a month; eight miles of 600-volt, d.c. catenary line, and two eighty-ton electric locomotives on yard service.

Woodwork and Timber Construction

Three types of launders are in use—all wood, wood with adamantine rock lining, and wood with concrete liners. No. 2 pine, surfaced four sides, 2 x 12-in. planks, is used for all launders. Plank launders are nailed with 16d. nails staggered from 2 to 2½ in. apart. The edges are lamp-wicked and then painted with white lead before nailing. On launders wider than one board, the edges of the bottom boards are ploughed, and a redwood slip tongue is used at bottom and sides. Adamantine blocks or cubes are cemented in with a rich grout. Launders thus lined carrying undersize from impact screens have been in service for a year without showing appreciable wear. A precast concrete liner, ½ in. narrower than the launder and cast 2 in. in thickness in short sections, has also been used and lasts on undersize from impacts eight or nine months.

Fir lumber is used for dimension stock and No. 2 common pine for concrete form work. Hardwood is used for screen frames, motor blocks, and shims. A well-equipped woodworking shop and lumber-storage shed are part of the repair plant. Eleven men are on shop work; three carpenters and two helpers and three screen men and two helpers are in the fine-crushing division; two carpenters and one helper in the ball-mill and rake-classifier division; one carpenter in flotation, and one in the dewatering department. A paint gang of six painters is under the carpenter foreman, who also has a crew of sixty-one men on new construction.

Machine and Metal Shops

Babbitting work is concentrated in one shop, which is in the fine-roll bay of the mill. An electric furnace is used for melting. Solid mandrels are used on split bearings and tapered mandrels on solid bearings, which are turned in a lathe afterwards. A special crew is engaged on this work. Machine, plate, tin, and forge shops are maintained as a supplement to the mill repair bays that are engaged upon routine replacements. All other work is handled in the shops.

An interesting appliance in use in the forge shop is a screen weaving machine which is used for manu-

Apron-feeder flights in yard storage

facturing all screens of ¼-in. wire or heavier. Cross wires are crimped by means of dies in the air hammer and are then woven on the screen machine. The screen is trimmed by a power shear and straightened out. Screens of smaller mesh are purchased. As in other shops, welding appliances are used wherever possible. The mechanical department in charge of the master mechanic employs 230 to 235 men, distributed to the different departments as follows: 14, coarse-crusher repairs; 35, fine crusher; 8, ball mill; 11, flotation; 5 salvage men; 15 outside repair machinists; 13, pipework; 32, machine shop; 30, boiler shop; 2, tin shop; 2, garage; 5 on wrecking crew; 9, miscellaneous construction; 26 on oiling gang, and 25 riggers. It takes 41 men per shift to operate the mill, or 123 shifts of labor per day. Repair, new construction, and miscellaneous total 477 shifts additional, or a ratio of about three shifts for each mill-operation shift.

A large warehouse for systematic storage and distribution of materials, spare parts, and supplies is maintained, as well as tool rooms in both machine and electrical shops. Yard storage is provided at convenient points. A Brownhoist and two Bay City locomotive cranes are available for use in handling heavy parts, and a standard-gage track system extends to each point where it is necessary to deliver heavy pieces.

The equipment of the machine shop is as follows:

2 bed planers; 42 in. by 12 ft.; 36 in. by 10 ft.
1 26-in. shaper
1 26-in. vertical slotter
11 lathes: 1 Bridgeport, 48 in. by 18 ft.; 2 36 in. by 12-ft. Lodge & Shipley; 3 24 in. by 8-ft. Lodge & Shipley; 2 18 in. by 6- and 8-ft. Lodge & Shipley; 2 14-in. Bradsford; and 1 12-in. lathe
2 5-ft. radial drills
2 drill presses; 18 and 24 in. vertical
3 boring mills; 10-ft. Niles vertical and 6-ft. Ballard vertical; 42-in. Niles horizontal
1 26-in. Newton cold cutting saw
2 milling machines: No. 2 and No. 4 Cincinnati
3 motor emery wheels and buffers
1 Universal grinder
1 500-ton hydraulic press
1 2-in. double-head Acme bolt cutter
1 15-ton traveling crane
1 electric welder
3 acetylene welders

Lessons from a Hoisting Accident

Broken Cable Caused Little Damage, Thanks to Counterweight—Virtues of Efficient Rope Lubrication

By Letson Balliet
Mining Engineer, Tonopah, Nev.

A LESSON in the care of cables may be learned from an accident that occurred at the No. 1 shaft of the Buckeye Belmont Mines Co., at Tonopah, Nev., on July 19. Though it did but slight damage, it might easily have proved costly.

The hoisting rope broke within 150 ft. of the top when a full loaded skip, carrying 3,000 lb. of waste, was being hoisted. As occasionally happens, the safety dogs failed to function.

In this particular case, the skip was counterweighted with a direct balance, and it rode the guides safely to the sump. The only damage was the breaking of the counterbalance sheave wheel when the counterbalance weight hit the top. Not a guide or a timber was scratched. The counterbalance, pulling 2,800 lb. of chain behind it, held the skip upright and allowed it to ride in suspension to the bottom. No one was hurt. Following is the history of the cables and a record of their care and use:

On Dec. 3, 1912, a ¾-in. high-grade plow-steel hoisting rope of six strands with nineteen wires each was placed in service at the No. 1 shaft of the Buckeye Belmont Mines Co. This rope was manufactured by one of the well-known makers of high-grade ropes. The skip weighed 1,800 lb. empty. It was a self-dumping skip, and carried a net load of 33 cu.ft. The skip was built in 1912. It was equipped with the usual safety dogs of the eccentric type that turn into the guides with steel springs when the cable breaks. The skip was counterweighted in direct balance with variable weights of my own invention. The patents incidentally have expired. Among the advantages of this counterbalance are its safety features, the protection against damages from a falling skip, the reduction in hoisting power or the increase of capacity for hoisting with smaller power units, lengthening of the period of use of the hoisting rope, and the saving in brake-block wear on the hoist. This counterbalance makes jerks and sudden pulls by the hoist engineer impossible; hence the ¾-in. hoisting rope had never been strained by a jerk.

From 1912 to 1917 this rope was in continuous service, hoisting from 1,200 ft. of depth, part of the time with three shifts a day, but nearly all of the time with two shifts a day. From 1917 to 1921 no work was performed through the No. 1 shaft. The hoist was used only occasionally for the maintenance of the shaft and for bailing a little water at intervals. In 1921 some work was done through this shaft, using the same cable. In May, 1922, a neighboring mine obtained an operating grant to work through this shaft into its own ground. This company removed both the hoist rope and the counterbalance, putting on a ⅞-in. plow-steel hoisting rope of a well-known brand. This rope was probably just as good in the beginning as the ¾-in. rope. The grantee, who was working through this shaft, operated to a depth of 1,500 ft. without the counterbalance, but pulled most of his loads from the 1,200 level, using an underground hoist below that point. This rope was undoubtedly subjected to the usual jerks with the required starting torque on the drum. The overcoming of descending inertia was performed by the hand brakes. There is no record that the rope ever had any severe strain or kink. The ¾-in. rope was wound on a reel and rolled out on the dump. A piece of galvanized iron was nailed over the drum as a partial protection from weather.

During all of the use of the ¾-in. rope, from December, 1912, to May, 1922, it had been frequently lubricated with light oils and cable lubricants, but it had never been coated with cable coating. It had been drawn through hot oil. It had been lubricated by dripping oil

over the sheaves, and every attempt had been made to keep the cable thoroughly lubricated to the core and throughout the 114 wires of its body. During the period that the shaft was idle the cable was wound on the drum inside the hoist house and was heavily painted with oil.

The grantees operating through the shaft in 1922 and 1923 used cable coating, a thick tar-like substance which was applied hot. When cold it became gummy, like rubber, and in cold weather it became more or less brittle and would crack where it was wound over the sheaves and around the drum. The lower half of the shaft was damp with dripping water, and through these small cracks in the cable coating the moisture seeped until the inside of the cable was damp and the moisture could not get out. It was afterward found that this condition caused bad rusting and pitting in the center of the cable, though the exterior looked almost as good as a new rope.

Counterbalance Again Used

From May, 1922, until July of 1923 the grantee who had a right to use this No. 1 shaft operated three shifts with the ⅞-in. cable unbalanced. In July of 1923 the cable was wound on the drum in the hoist house and the shaft was inspected only intermittently and maintained in repair until February, 1925. On that date work was again begun through this shaft, the operators again using the ⅞-in. cable that was upon the drum, but the counterbalance was again put in service, using the ¾-in. rope that had been taken from the drum in 1922. From February of 1925 until July 19, 1926, the two ropes ran parallel in the same shaft, the smaller one on the counterbalance and the larger one on the drum. Both ropes would pass inspection any place. Both seemed to have perfect exteriors. One had been kept thoroughly lubricated throughout its entire diameter and the other one had been coated.

During my absence from the mine I discovered that the employees had used cable coating on both cables, instead of lubricants. On inquiry the foreman said with some merit in his reply, "It won't do no good to put on oil or lubricants after the cable has been doped with that stuff, so I thought I had better keep them coated." Every sixty days or so the cables were coated.

On July 19 the hoisting cable broke inside the hoist house. The hoisting engineer saw one strand first fly out and begin to unravel, and a second or so later the cable parted within a few feet of the drum, the dogs failed to work, and the loaded skip went to the sump with the ¾-in. cable that was fourteen years old fighting to hold it every foot of the way and with every one of its 114 wires doing its full duty. The counterbalance cable gave way under the cable clamp next to the thimble eye and pulled itself through four cable clamps but without otherwise breaking.

Regarding the counterbalance, I have often made the statement, "A man can ride to the bottom with the dogs blocked if the hoisting cable is cut off." I have never wanted to try it, nor would I let anyone else try it, but my calculations were that with 150 lb. overload the descending speed would not have killed a man on the cage, but I never in my calculations thought that 3,000 lb. overweight on the skip side would ride so smoothly through to the bottom without breaking a guide or a timber.

It is obvious that in addition to the weight of the counterbalance dummy and 2,800 lb. of chain, the friction of the skip guides, counterbalance guides, and the sheave also had to be overcome. I have estimated that the descending time for 1,200 ft. after the hoisting rope broke was about half a minute; hence it would seem that the acceleration for the thirty seconds must have been about "2" against the counterbalance and the normal friction.

The counterbalance dummy, which operated on a single T-shaped guide, to which the chain was fastened, was moving at such a speed after the skip hit the water in the sump that the dummy, dragging 2,800 lb. of chain behind it, broke the sheave wheel and one of the caps that carried the sheave and dropped to the ground over one of the back legs of the headframe without other injury or damage. If it had not been for this counterbalance, I am satisfied that many feet of the shaft timbers would have been ripped out, and the pump column, air column, and power cables would have been a tangled mass of wreckage, the repair and replacement of which would have cost many thousands of dollars. The lower levels of the mine might have become filled with water and the pumps might have been lost.

Sections of both cables show that the fourteen-year-old cable is free from rust and well lubricated even to the hemp core, while the larger cable that is only four years old is pitted and rusted on the interior. It seems obvious that lubrication with a penetrating oil is much to be preferred to cable coatings where used in a damp or wet shaft.

Lead-Lined Valves for Leaching Plants

Valves for use in the new copper-leaching plant of the Inspiration Consolidated Copper Mining Co., at Miami, Ariz., are known as "fourteen-inch bottom outlet diaphragm pattern flanged acid valves." These valves have a constant horizontal flow and are installed to control the flow of solution through the bottom outlet into treating tanks. The bodies are of 6 per cent antimonial lead and the yokes and bonnets are cast iron. The solution comes in contact only with antimonial lead and rubber.

The shut-off consists of a large lead-covered brass disk fastened to a lead-covered brass stem. This disk is also equipped with an acid-resisting rubber disk which permits of better seating qualities. No stuffing box is used, for the solution is kept within the body by a rubber diaphragm extending over the top body flange and held in place by the bolts securing the bonnet to the body. The diaphragm is also securely fastened to the steam and has sufficient play to permit full opening of the valve.

Each valve weighs approximately 2,100 lb. and the total net requirements for the order consisted of the following:

	Tons
Antimonial lead	58
Cast iron	14
Brass	4
Rubber	1½
Bolts, washers and nuts	1½

Montana Mineral Production in 1925

The U. S. Department of Commerce reports the following mineral production for Montana:

	1924	1925
Ore treated, tons	4,652,482	4,405,008
Gold production, oz.	97,854	82,123
Silver production, oz.	13,289,303	13,158,191
Copper production, lb.	249,152,062	268,910,847
Lead production, lb.	39,476,008	37,530,644
Zinc production, lb.	128,475,218	115,316,922
Total value	$55,074,548	$61,044,006

Sources of Error in Assaying Tin Ores by the Pearce-Low Method

Impurities Not the Only Cause of Inaccurate Results—Improper Procedure, Physical Conditions, and Purity of Reagents Important Factors Often Receiving No Attention

By Gerald U. Greene
Llallagua, Bolivia

ERRORS in the assay of tin ores and concentrates by the Pearce-Low method are usually considered as being caused by the other constituents of the ore, but this is an erroneous impression, due to a lack of proper research work. The inconsistent and incorrect assays obtained by this method are generally attributable to the acidity of the solution, the volume, and the physical condition of the nickel used for the reduction. Two or three elements invariably give high results, but these results are not uniform. That is, the results, when plotted with increasing amounts of the elements, do not give a straight line.

The interfering elements can be divided into five classes: (a) those that invariably give high results; (b) those that interfere only in the presence of some other element or compound; (c) metals that are precipitated by the iron or nickel used to reduce the tin; (d) elements that apparently affect other elements or compounds present; and (e) elements that may interfere in solutions of low or high acidity.

Class (a)—Tungsten and molybdenum comprise this class.

Class (b)—Phosphorus, titanium, lead, and zinc are representatives of this type.

Class (c)—Copper and bismuth.

Class (d)—Sulphur.

Class (e)—Arsenic, antimony, and iron.

The results obtained in the presence of tungsten and molybdenum are shown in Table I.

Table I

Impurity	Amount Impurity Present, Mg.	Tin Present, Mg.	Tin Found, Mg.
Wolframite	50	59.10	62.70
Wolframite	75	22	71.55
Wolframite	100	22	68.40
Wolframite	200	22	71.00
Molybdenum oxide (MoO_3)	25	22	61.15
Molybdenum oxide (MoO_3)	50	22	63.25
Molybdenum oxide (MoO_3)	75	22	63.75
Molybdenum oxide (MoO_3)	100	22	65.85

Tungsten not only gives high results, but with over 10 per cent present it is practically impossible to determine the correct end point in titration. The blue color caused by tungsten and stannous chloride slowly fades as the tin becomes oxidized, and with low percentages of tungsten the true end point can be determined easily. This element interferes in either oxide or sulphide ores. Molybdenum causes greater error in high sulphide ores. For this reason it could also be placed in Class (b).

Titanium, according to Wraight and Teed,[1] interferes only in the presence of tin salts. Phosphorus, lead, and zinc affect the assays only in high sulphide ores. The results secured in the presence of these elements are given in Table II.

The effect of sulphur on phosphorus is remarkable. It may be that in the fusion the sulphur fixes the phosphorus as the sulphide. Then it is present as the trichloride during titration, and possibly would consume iodine. This explanation is here offered only tentatively.

Copper and bismuth are the principal metals of Class (c). Antimony could also be included in this class, but since it interferes in solutions of low acidity, it has been placed in Class (e). Bismuth may be precipitated quantitatively by using 25 to 30 sq.in. of nickel for the reduction, and under these conditions it does not

Table II

Impurity	Amount Impurity Present, Mg.	Tin Present, Mg.	Tin Found, Mg.	Sulphur, Average Per Cent
Titanium oxide (TiO_2)	50	52.80	56.64	.....
Titanium oxide (TiO_2)	75	52.80	54.08	.....
Titanium oxide (TiO_2)	100	52.80	53.57	.....
Lead	...	52.80	52.30	3.02
Lead	...	84.74	85.50	18.95
Zinc	...	52.80	52.81	3.02
Zinc	...	84.74	83.98	18.95
Phosphorus	...	52.80	52.72	3.02
Phosphorus	...	84.74	87.30	18.95

interfere. Copper may give either high or low results according to the relative amounts of tin and copper in solution. The area of nickel used for reducing the tin and the time of reduction also have their effects. With high copper and low tin content, the copper is generally not precipitated quantitatively. This copper consumes iodine, and often will cause serious errors in assay. Ores containing high percentages of both copper and tin will give low results, owing to the mechanical action of the precipitated copper. In some instances I have found as high as 50 per cent of the tin in the precipitates. Low percentages of copper may be precipitated quantitatively without affecting the assay.

High or low results (assuming an ore with over 5 per cent of tin and copper) depend more upon the volume of solution, the acidity, and the area of nickel than upon the relative amount of tin and copper present. Or it may be stated that the results obtained are a function of the time of precipitation of the copper, and vary directly as the time, in a moderately acid solution. That is, if the copper is precipitated rapidly, some tin will be carried with it; if precipitated slowly, the precipitation is evidently not quantitative.

Table III gives the results obtained in the presence of minerals of Class (c).

Table III

Impurity	Amount Impurity Present, Mg.	Tin Present, Mg.	—Tin Found, Mg.—	
Bismuth	20 to 80	50.53	50.53	.....
Copper	10	101.06	100.94 (*a*)	100.43 (*b*)
Copper	20	101.06	100.94	92.89
Copper	30	101.06	108.72	89.32
Copper	40	101.06	110.76	84.73
Copper	50	101.06	97.88	85.24
Copper	75	101.06	64.82	81.15
Copper	100	101.06	59.72	68.39

(*a*) Reduced with nickel. (*b*) Reduced with horse-shoe nails.

The effects of sulphur, Class (d), were shown in Table II. Treatment with aqua regia, or roasting at a low temperature, will remove the sulphur and also elim-

[1] *Bulletin*, Institution of Mining and Metallurgy, London. Feb. 1924.

inate the errors caused by Class (b). It is preferable to remove the sulphur by roasting, when the ore contains soluble tin minerals.

Arsenic and antimony, according to Low,[2] will consume iodine in a weak acid solution. The method of preventing this error is obvious. The amount of iron in the ore is never sufficiently great to interfere; what causes trouble is the relatively large amount dissolved from the iron crucible used for the fusion. Iron apparently interferes in highly acid solutions, giving very erratic results.

If the errors in the assays were caused only by the elements or compounds mentioned above, a more uniform curve would be expected, though this statement obviously does not apply to classes (c) and (e). Since the results are erratic, it is evident that the differences found are not entirely attributable to these impurities. Consider the effects of acid concentration. As all of the other constituents are present, one is not justified in claiming that the total error is due entirely to the acid, but one is justified in saying that the acid is one of the principal contributing factors to the erroneous results.

Effect of Acid Concentration

The results shown graphically in Fig. 1 illustrate the effect of acid concentration. It will be noted that with an increase of acid above 60 c.c., a decrease in tin is obtained when the fusion is made in nickel crucibles. The curves plotted with the assays obtained after fusion in iron crucibles, with the exception of the lower ones, do not even approximate those plotted with the results secured after fusion in nickel crucibles. These curves show the effect of acidity and the effect of iron. It is difficult to explain why in one case the iron should give low results and in another case give results higher than those obtained with the same ore fused in nickel crucibles. The low results can be explained by assuming oxidation of the ferrous chloride. This compound would then oxidize the stannous chloride according to the following equation:

$$2FeCl_3 + SnCl_2 \rightarrow SnCl_4 + 2FeCl_2$$

The high results can be explained in an analogous manner. Assume no oxidation of the ferrous chloride before titration. During titration this compound will consume iodine, consequently giving high results. The vital question is, however, why should one series give high and the other low results. The answer evidently must be sought for in the physical condition of the solution. It is more difficult to answer when it is considered that all the solutions were practically identical except in the matter of the acid concentration. They were reduced with equal amounts of nickel and for the same length of time. Also they were all placed in the same furnace, thus having practically the same temperature.

Lower results are generally obtained with commercial acid, probably owing to the presence of precipitants of tin.

Table IV

Sample No.	Tin Present, C. P. Acid, Per Cent	Tin Present, Commercial Acid, Per Cent
1	44.66	46.82
2	52.92	51.57
3	53.37	52.02
4	41.18	40.66

[2] "Technical Methods of Ore Analysis."

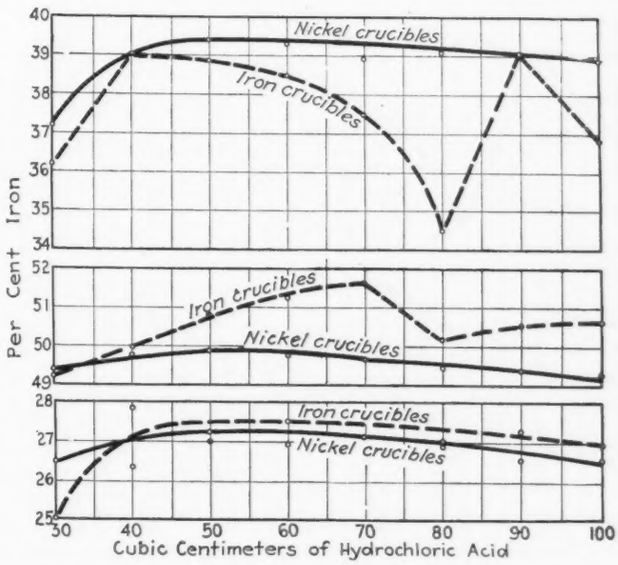


Fig. 1—Curves showing results obtained on the same ore with varying amounts of hydrochloric acid, using iron and nickel crucibles.

C. P. Acid vs. Commercial Acid

Much commercial hydrochloric acid contains sufficient sulphate ions to precipitate the tin. It should therefore be tested before being used. Table IV contains the results obtained when both C. P. and commercial acids are used.

Effect of Volume of Solution

A large volume of solution apparently prevents the quantitative precipitation of the copper. A rapidly fading end point is often obtained in solutions having a volume much over 300 c.c. On the other hand, a small volume is often colored a dark green by the nickel in solution, and the end point may be passed.

Physical Conditions of the Nickel Used for Reduction

That sheet nickel, after having been used for several reductions, attains a passive state is not generally recognized. In this state it is difficultly soluble, and low results are often obtained. The curves in Fig. 2 illustrate this tendency. By the term old nickel is meant nickel that has been used at least one-half the number of times that it is possible to use it, this factor obviously depending upon the thickness of the sheet nickel.

Nickel vs. Iron for Reduction

Either nickel or iron are generally used to reduce the tin. Table V shows the differences found when both were used in a test to determine their respective reducing qualities. Column *A* gives the assays secured by reducing with iron horse-shoe nails; Column *B*, those obtained by reducing with sheet nickel.

Table V

A Tin Assay, Per Cent	*B* Tin Assay, Per Cent
0.4	0.4
0.7	0.7
6.0	6.3
8.8	11.6
23.7	30.1
28.7	31.3

Since the iron used for the reduction was considered pure, it is apparent that nickel is the more efficient reducing agent.

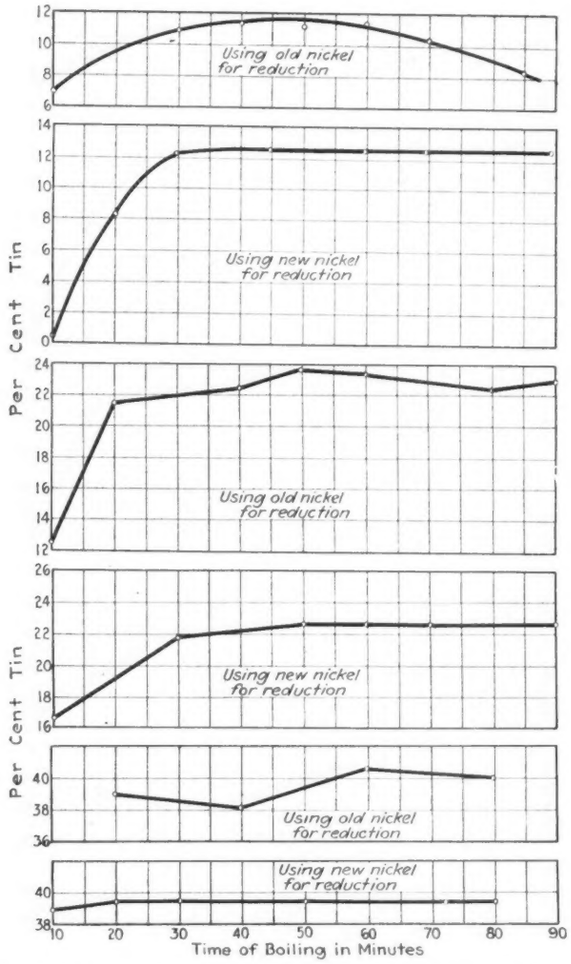

Using old nickel for reduction
Using new nickel for reduction
Using old nickel for reduction
Using new nickel for reduction
Using old nickel for reduction
Using new nickel for reduction
Per Cent Tin
Per Cent Tin
Time of Boiling in Minutes

Fig. 2—Curves showing effect of old and new nickel on assay results for various times of boiling.

Table VI gives the results obtained when a copper-nickel alloy was used to reduce the tin. The alloy contained approximately 45 per cent copper.

Table VI

Tin in Ore, Per Cent	Tin Found, Per Cent
0.56	30.01
0.34	20.07
0.20	20.57
0.10	17.89

I have attempted to show in this article that the greatest errors in the Pearce-Low method of assay of tin ores are caused not by the constituents of the ore but by the chemical reagents added in the course of the assay. No other justification need be found for this article if the data given here will convince chemists of the necessity for greater care in the selection of the quantity and quality of the chemicals used.

Transvaal Percentage of World Gold Production Declines

Although the Transvaal output of gold established a new high record in 1925, it is interesting to note from the annual report of the South African Chamber of Mines that this area's percentage of world production has shown a small but progressive decline during the past three years, according to the U. S. Department of Commerce. The largest proportion to the world total was reached in 1923 with a percentage of 52.6. This fell to 51.6 per cent in 1924, and last year the ratio was 51 per cent. World production of gold in 1925 is estimated by the Chamber of Mines at 18,829,269 oz., with a valuation of £80,000,000. Of the total the Transvaal contribution was 9,597,573 oz., valued at £40,767,901. Taking gold at its standard value this is the highest figure ever attained by the local mines.

The United States was the second largest producer, supplying 2,376,614 oz., or 12.6 per cent. As the 1924 output was 2,511,243 oz., or 13.5 per cent of the total, the last year's figures represent a decline both actually and relatively. Canada on the other hand shows expanding operations, the output advancing from 1,233,601 oz. in 1923 to 1,525,000 in 1924 and to 1,740,386 in 1925, an increase in the ratio from 7 to 9.2 per cent.

French Bauxite Production, First Half of 1926

The French output of bauxite during the first six months of 1926 is reported to be slightly higher than that for the corresponding period of 1925, and it is said that it would have been still higher but for the shortage of labor. Official figures for the 1925 production have not yet been received, but estimates place it at about 390,000 metric tons, according to reports to the U. S. Department of Commerce.

Further small deposits in the Departments of the Bouches du Rhone and the Var have been purchased by one of the important French automobile interests, which began taking over some of the smaller concessions shortly after the war. It was then understood that ultimately this company would erect extensive plants for the conversion of bauxite into aluminum, for the use of its automobile works, but no progress has been made in this direction as yet.

French prices of bauxite have advanced during the last few months as a result of the higher cost of production, which, in turn, can be traced directly to the depreciation of the franc—so that upon conversion to dollars this year's prices appear considerably lower than those of 1925.

Exports of bauxite to England, Germany, and Switzerland continue regularly, but none of this mineral has been shipped to the United States since October, 1925, and the last important lot destined for this country was a shipment of 5,088 tons in June, 1925. In 1924 the United States received a total of 15,618 tons of French bauxite. This decline in purchases is partly attributed to the greater reliance of American aluminum manufacturers on the deposits in British Guiana. It has been recently reported, however, that about 6,000 tons of bauxite will leave France in the near future for an American destination.

The Rumanian Petroleum Industry in 1925

According to reports to the U. S. Department of Commerce, two factors largely contributed to a favorable development of the Rumanian petroleum industry in 1925—the partial removal by the government of various restrictive measures relating to price control and the judicious enforcement of certain provisions of the mining law. Owing to the unsatisfactory returns from export taxes imposed on petroleum products, and to further the increase of petroleum exports, the government gradually reduced taxes thereon and allowed more liberty for internal trade. At the same time it endeavored to remove the unfavorable impression created by the mining law, and to this end sought a mild interpretation thereof and a lenient enforcement.

Useful Operating Ideas

Utah Safety Rules for Metal Mines

THE following safety rules for metal mines are taken from a booklet issued by the Industrial Commission of Utah and were prepared by E. A. Hodge, state metal mine inspector:

General

Any condition noted which is likely to cause injury should be reported to the management at the earliest possible time. This applies to everyone working in the mine.

Do not wear loose or baggy clothing around machinery.

No matter what you are doing, think ahead of what could happen to you in any position you may assume and keep in the clear.

When filling your container from a carbide can keep your light a safe distance away and have no lighted pipe, cigar, or cigarette near.

Beware of deadly mine gases. Do not enter old workings or pass a barricade without special permission, and then be extremely careful. Watch your light; you cannot see or smell the gases, and they act quickly.

Surface

1. Do not displace guards about any power-driven machinery.
2. Oilers should use great care when working about overhead drive shafts and pulleys; use runways provided for your protection.
3. Use care in piling lumber and timber in all surface yards; see that you leave sufficient clearance for cars and wagons and pile material so that it will not fall.
4. Use safety ropes provided when going into ore bins for any reason, and promptly report to your boss any rope that appears to be in dangerous condition.
5. Do all you can to keep hoist rooms neat and orderly.
6. Obey safety rules and do not talk to or otherwise distract the attention of the hoisting engineer on duty.
7. Do your part to keep turn-sheets and floors about shaft collars smooth and orderly.
8. Do not leave tools, timber, or any other loose material near the collar of a shaft. It is likely to cause a stumble or be pushed into the shaft, thereby causing injury to you or a fellow workman below.
9. Keep guard rails or gates at shaft collars in place at all times, except when the cage is actually spotted. When you raise them, see that they are securely fastened against falling.
10. Always wear goggles when doing chipping or grinding work. Protect your eyes; you can never get another pair.
11. Do not take short cuts to or from work; use regular travel ways.
12. Keep off railway tracks, except at regular crossings.

Shafts

1. Be conscientious and thorough when you are detailed to inspect hoisting ropes, cages, king bolts, safety catches, guides, and shaft timbers. Do not fail, delay, or hesitate to report any defect you have not corrected.
2. Report immediately any defective guard rails or lights at underground stations and skip chutes.
3. Do not leave tools or other loose material within 10 ft. of shaft at any underground station.
4. When working in shaft, protect yourself, whenever possible, against material falling down the shaft.
5. Do not fail to see that cage door is closed when four or more persons are riding.
6. Unless you are the cage rider, do not ride on the same deck with material other than that carried by hand.
7. Be sure that safety hook is securely locked before you give signal to hoist a bucket.
8. Put out your open light when riding on a cage.
9. Do not ride on skip or bucket not provided for that purpose.
10. Do not lean over guard rails at shaft stations.

Underground Stations

1. Signals that control movement of cages must not be used by anyone except station tender or cage rider.
2. Do not scuffle, crowd, or indulge in any "horse play" about shaft stations; they are dangerous play grounds.
3. Help keep stations clean and orderly so as to reduce both the accident and fire hazard.

Drifts and Crosscuts

1. When a moving train is approaching, allow yourself ample time to take refuge where there is sufficient clearance for you. Do not take chances; the train cannot turn out and may not be able to stop in time. Look for a second train before you step back on the track.
2. Where necessary, lag back and sides of timber sets.
3. Report at once any defective timbering or loose backs in haulageways.

Track Work

1. Report at once any track conditions that might cause derailment.
2. When working in haulageways clean up any rock or other material which you have put there.
3. Do not leave any old turn sheets, pipe, rails, tools, or any other material near the track on haulageways.
4. Remember that projecting nails, pipe hangers or sharp-pointed metal pieces cause many injuries in haulageways; don't leave them there.

Tramming

1. Keep your fingers off top and sides of car when tramming; there is danger of crushing fingers against projecting sides or chutes.

2. Except where absolutely necessary do not pile timber or other material along track in haulageway. When it must be piled there, make sure that it cannot become displaced and that it leaves ample clearance for passing cars.

3. No cars should be left in haulageway without a light; many men are hurt in collisions.

4. See that a tail light is burning on all moving trains.

Motors and Cars

1. Motormen should use their gongs freely. Don't speed. Keep your train under full control at all times. "Give the man on foot a chance."

2. Keep off motors and cars unless you are a member of the train crew.

3. Do not place long tools or material on motor or cars; use a truck.

4. Do not put powder on an electric locomotive.

5. Do not push loaded trucks ahead of motor, except when absolutely necessary.

6. Do not get off or on motor or cars when they are in motion.

Handling Material; Loading Cars

1. Do not carry tools, pipe, rails, or other material upon the shoulders in any haulageway where electric wires are installed.

2. Use a side board when loading from a chute and trim all loaded cars so they will clear all chutes and timbers.

Powder Magazines and Fuse Stations

1. Keep powder magazines and fuse stations dry and well ventilated, and free from rubbish, and use only electric lights where they are provided. Never smoke or take an open light into a magazine.

2. Always place powder and caps at least 25 ft. apart underground.

3. Do not leave powder, caps, or fuse loose in any working place; put them in the powder magazine, fuse station, or in boxes provided for the purpose.

4. Use only wooden mallet and wood chisel in opening powder boxes.

5. Powder men should see that their powder sacks are free from holes.

Tools

Keep your tools stacked up neatly. When blasting, leave the tools in the clear; not in direct line of the blast. Hang up your saw.

Barring Down

1. Examine the back and sides before going to the breast; the blast may have loosened something and made it unsafe.

2. Be sure that no one is under you when barring down.

3. Always have a sharp pinch bar handy.

4. Keep floor clear behind you, so that you will not stumble when stepping back.

5. When taking down a large piece of rock or slab, follow its probable course before you dislodge it, and satisfy yourself that it will not bring down the stull or timber you are standing on and will not strike you or anyone below.

Floors

1. When entering a stope, first examine the floors; see that all boards have a safe bearing. Lay them tight and wedge between the posts.

2. Clear the working floors before barring down.

3. Keep all unused tools and other working material stacked neatly out of the way.

Chutes

1. Line up braces and make them tight before lining the chute.

2. Always line chutes to the working floor and securely block grizzlies.

3. If ore pockets are not provided with proper grizzlies, notify your shift boss.

Timber Slides

1. Use not less than 2-in. material for slides.

2. Stand back out of the way when hoisting timbers or other material; something might come down the slide and strike you.

Blasting

1. Always give warning and guard all approaches before you blast.

2. Keep powder and primers separated at the face when loading holes.

3. Use only wooden rammers to tamp drill holes. Do not tamp by strokes, but only by direct and steady pressure.

4. Do not fail to count your shots and report any missed holes to the shift boss. Look at the bulletin board before going on shift.

5. Do not enter working places with missed holes for at least forty-five minutes from time of spitting.

6. Do not attempt to extract the charge from a missed hole; insert a fresh charge and fire it.

7. The blasting charge should be prepared as follows: Make a hole in the end of the stick of powder with a wooden peg, insert the primer and securely tie the stick to the fuse and insert the cartridge in the bore hole the straight way.

8. Use a spitter to ignite the fuse; not a cap lamp.

9. Do not smoke or have a lighted cap lamp on your head when loading holes. Hang your lamp in a safe place at one side.

10. Have a reserve light in a convenient place for use in case your light goes out.

Holing

When holing into the workings that are used for travel, see that all directions leading to the place to be holed are guarded during the blast.

Manways

1. Use care in passing under manways and chutes; something might drop on you.

2. Do not throw steel down manways; lower it with a rope.

3. Use every effort to keep ladders in good repair. Notify your boss at once when you note any defect that you cannot correct yourself.

4. Guard rails erected at places where a man might fall into manway, chute, or timber slide are for your protection; repair or report defects at once.

5. Keep manways free from obstruction and safe

from fall of rock by lagging the walls wherever necessary.

6. See that guard rails at crossovers and timber slides are kept in position.

7. Face the ladder when you are descending it.

8. When you ascend a ladder adjoining a chute, take time to notify the party above that you are there.

Stopes and Drilling

1. Bar down before you start to drill.

2. Do not drill into loose ground until you make it safe by barring down or timbering.

3. Carefully examine the back or face and see there are no missed holes before you drill.

4. Do not drill from an improper staging.

5. Never drill into a "bootleg hole." There may be some powder in the bottom.

Mucking

Do not work under bad ground. If in a square-set stope, see that the floor is tight over your head; if in a rill stope, keep the rope near at hand.

Timbering

1. Do not work under loose ground; if in doubt, timber.

2. Do not use too small timber in a wide or heavy stope.

3. Where lagging is necessary, put it in as you place the set.

4. When in a rill, put in a stull if the walls appear unsafe.

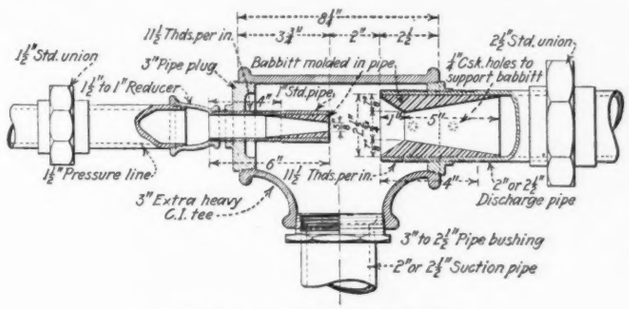
5. Whenever possible, set posts vertically over posts; not out on cap or girt.

6. Always use good head-boards in stull stopes.

7. Use as few wedges as possible in blocking square sets; use substantial blocks.

Hydraulic Eductor for Sump Drainage

A simple type of water eductor operated by water under pressure has been used at the Bingham and Pittsburgh-Idaho mines of the U. S. Smelting, Refining & Mining Co. The eductor is used for draining sumps, pockets, and shallow shafts while they are being deepened. The accompanying sketch shows the general



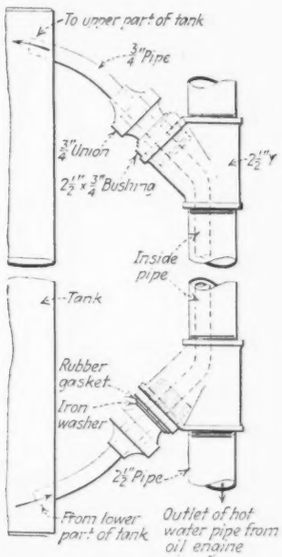
Design of Water Eductor

design of the eductor, which was constructed in the shops. Suction is continuous and the eductor starts quickly. It is not particularly efficient, as about an equal quantity of pressure water as compared to the water removed from the excavation is required. However, it is a light, portable rig that does not take up much room. Its handiness overcomes its lack of efficiency. At an altitude of about 7,000 ft. the eductor will lift approximately 22 ft., or about 20 per cent of the available pressure head.

Keeping a Solution Tank From Freezing

By Charles Labbe
Death Valley Junction, Calif.

Last winter it was necessary to keep a solution tank from freezing. Many experiments were made, but the one here described proved the simplest and best. The plant was operated by an oil engine, the water-cooling outlet pipe of which was altered as follows: The long



Detail of Sleeve Piping Used to Warm Solutions

piece of 2½-in. pipe was taken out and cut in two places to permit placing in the line two Y fittings, as shown in the accompanying figure. A ¾-in. pipe was run from a point near the bottom of the solution tank and another connection of the same size made on the tank about one-third the distance from the top, the pipe being extended to each Y fitting. From one Y to the other a piece of pipe of the same size was placed inside of the hot-water pipe, thus forming a thermo-syphon which kept the solution from getting to the freezing point.

To make the connection at the Y, the inside pipe was cut off to the required length after trying it in place, the threads at each end being cut about ¾ in. Into the small openings of the bushings a tap was extended from the inside to about half way, so as to give some taper to the threads on the reverse side, but still not making the hole larger than necessary. After slightly bending both ends, the ¾-in. pipe was placed inside the large one, the ends extending through the Ys; the bushings were screwed on the small pipe to about four or five threads and then into the Y's when tight, not less than ¾ in. of the ¾-in. pipe extending beyond the bushing. A rubber or leather washer was then put over the ¾-in. pipe and a light iron washer over this. A ¾-in. union was then screwed on the ¾-in. pipe, the half near the bushing acting as a lock nut and preventing leakage. The connections to the tank were made next. It was found necessary to insulate the ¾-in. pipe by strips of old canvas wound around the pipe and held with adhesive tape where needed.

Discussion

The Early Fight for the Cyanide Patents—A Little Bit of History and Gossip

THE EDITOR:

Sir—In your issue of June 19, 1926, Alfred James, a well-known metallurgist, contributes some interesting observations on patent litigation, and having been on both sides of the fence in the matter of patent litigation I am in a position to offer both sympathy to the loser and congratulations to the winner. In other words, I know exactly how both feel, having been in the position of both winner and loser—but not both at the same time. In the patent litigation over the cyanide process in the Transvaal about the same set of circumstances were in evidence as occurred later in the United States over the Mineral Separation process.

The cause of the fight in each case was just a little matter of price, and as there was no doubt about the greater profits to be earned by the use of either of the processes, there should have been no trouble; but there was trouble, and to put it plainly the industry thought that the McArthur people asked too much when they charged 10 per cent royalty, but quite possibly they did not ask too much. In any case the McArthur people made a number of very profitable contracts at probably much lower prices. They had a wonderful process and a tremendous demand, a situation more than enough to turn the head of even the canny Scotchman that controlled the patents, the same situation occurring with Minerals Separation before the death of Mr. Ballot. But it was not always a matter of price alone with the McArthur people; there were some to whom they refused the use of the process regardless of price. They had a perfect right to do so, but, as one can imagine, this produced an entirely uncalled-for opposition, and was the immediate cause of what ended as a total loss of the most valuable patents in the metallurgical world at that time or possibly at any previous time.

When I went to South Africa I carried in my hat what I thought at that time was a cure-all process for the ores of Johannesburg. I went as an assistant to Hennen Jennings (no kinder or more able chief could any one have had). He advised the firm of H. Eckstein & Co. (the Corner House) to build a chlorination plant at the Robinson mine, which we did; and the five-furnace plant ran most successfully for several years. William Mein came out and took it over from me. The yearly extraction at the plant was around 97 to 99 per cent on purchased concentrates.

John McArthur told me quite frankly at the time the plant was under construction that it would be a failure, as three other plants had started and failed and all were built by men who, he said, knew quite as much as we did. He attributed their failure to the use of the high-sulphur, high-ash coal, with which a dead roast could not be produced, but there was something more. The McArthur people, with a new process to exploit, scented danger when Jennings and the Corner House were planning to adopt an opposition process, but they did not realize Mr. Jennings' fairness. No sooner was our chlorination process running and a huge success, than Jennings offered the McArthur people a fine contract on the Robinson tailings, running about four to five pennyweights. Alfred James put Mr. Darling in charge, and they installed in a short time a plant treating somewhere around 2,000 tons, or possibly more, tailing per month. This plant was an immediate success. I did not believe that they could produce the results that they claimed on unroasted pulp. As I was metallurgist for the Robinson company I watched the operation closely and when I saw the first clean-up, saw the gold weighed, and knew what they had recovered, I rushed out, mounted my horse, rode to the Corner House, informed Mr. Eckstein of what I had seen, and recommended the purchase of the patents for Johannesburg at any price. Mr. Eckstein called in Mr. Jennings, and he, being more moderate than I, said we should not be too hasty; but then and there I was convinced of the value of the patents. From that time on, the McArthur people were in clover. The Corner House delayed, and later it was too late, but not everybody who began to use the process made contracts.

About a year after this I formed among a strong group of capitalists, The Rand Central Ore Reduction Co., and started to build cyanide plants to treat tailings from various companies, expecting to make a contract with the McArthur company. However, when our company tried to make a contract we could not get anywhere. After considerable negotiation we offered to pay 2 per cent and 15,000 shares, quoted at £3 per share, for a license, but we were turned down and informed we would not be allowed to operate. However, we went on building plants and operating, and as our directors were among the big men it shortly became known that the Rand Central was operating in the face of a refusal to give them a license. Very soon only those holding licenses were willing to pay, the balance holding off until they knew what the scrap was all about.

During this long-drawn-out fight, that cost the industry £225,000 in expenses, all kinds of get-together, hands-across-the-sea meetings were held, the industry offering about 3 per cent and the patent exploiting company holding off.

During this time, in order to safeguard the Rand Central, our company made a contract with Siemens & Halske for their electrical cyanide process and we soon had a number of plants licensed at 2 per cent royalty. Now that there was real live opposition in the camp, the mining industry determined to fight it out, knowing they had a retreat if they lost. There was a fair fight and a hard one, and it is a weak statement that our friend Mr. James makes when he lays it all on the minister. They lost because they were fairly beaten.

There never would have been a fight on a 3 per cent royalty, which the industry was willing to pay, if the McArthur people had used the wise policy of Dorr or Oliver, the policy now being persued by the Minerals Separation. They would never have lost their position.

Mr. James should not talk of a high standard of morality when the Scotchman asks 10 per cent and the Jew offers 3, and then blame the loss of the business on a doctor of divinity. That is the biggest joke ever. I hope my old friend Alfred will not take this too seriously.

Johannesburg had a sporting bunch of business men as leaders: Alfred Beit, Julius Wernher (afterward Sir Julius), and H. Eckstein, the head of the Corner House, all three splendid, big-hearted, generous men. Then there was the Goldfields, Cecil Rhodes' company, represented by his brother Frank Rhodes; and other able groups like Barnato Bros., the Albus, Adolf Geortz, advised by Hennen Jennings, John Hays Hammond, with Pope Yeatman and Fred. Hellman, Tom Leggett, and Captain Tom Mein, as fair and just a lot of men as you could find. These men were the advisers of the group who were willing to pay a fair royalty but refused to be held up. These men had the same high standard of morality then that they have now.

Surely there never should have been a fight. There was a fine opportunity for a compromise, because McArthur had certainly made a wonderful contribution, and the industry surely needed his process and the ability of his brilliant staff, led by Alfred James.

Jicaro, Nicaragua. CHARLES BUTTERS.

The Illinois-Kentucky Fluorspar District

THE EDITOR:

Sir—The article "The Illinois-Kentucky Fluorspar Industry," by Albert H. Fay, appearing in your issue of July 31, presents an erroneous picture and does injustice to those, of whom I am one, referred to by the author as "local holders of fluorspar property."

Mr. Fay quotes F. Julius Fohs in a twenty-year-old Kentucky Bulletin and says, "Deposits are enormous," and gives Fohs' estimate of the Kentucky total as 200,000,000 tons. The price twenty years ago was from $5 to $6 per ton and now is (also the round figure average for the post-war years) $18 for the common fluxing grade. Is it conceivable that both statements—that of enormous tonnage and that of trebling in price—are true of an industry which Mr. Fay says can enjoy good business only when general business conditions are good? If the statement of tonnage were true, fluorspar would not bring $4 per ton. The fact is that Fohs' estimate was one hundred times too high. The president of the company owning the greatest number of mines in this field, himself a mining engineer of high reputation and wide experience, writes "There may possibly be two million tons of recoverable commercial fluorspar in the whole state of Illinois." It is pertinent to mention that the Illinois production from 1902 to the end of 1924 is 71 per cent of the whole Kentucky-Illinois field. Your editorial in the issue of June 12, 1926—with special reference to the first sentence of the fourth paragraph—is perfectly fair and true. The exceptions to the statement you make there, that "The workable bodies of fluorspar practically disappear within the limits of mining operations of only moderate depth," are unknown.

The article contains a table listing producers down to 1,500 tons per annum for one eight-hour shift operation, and up to 30,000 tons for the former largest producer, but fails to say anywhere that the Rosiclare mine, and the adjoining Fairview mine on the same vein, now owned by the Franklin Fluorspar Co., a subsidiary of the Aluminum Company of America, are flooded with water from the Ohio River, coming through vein channels, and have been for two and one-half years in the case of the Rosiclare mine and for over three years for the Fairview. For such comparatively small tonnage mines in the sere and yellow leaf, he would be an undiluted optimist who would predict their unwatering unless fluorspar prices advance greatly. From these same two mines has come in the past almost the whole of the Illinois production!

The article gives the value per ton of imported fluorspar as $9.63 for 1925. It should have stated explicitly, if such were the case, that this was the value at foreign mines. In "Fluorspar and Cryolite in 1924," by Herbert W. Davis, U. S. Department of Commerce, it is stated on p. 69 that "The value at foreign mines averaged $10.89 a ton" and "the cost to consumers in the United States is reported to have ranged between $16.75 and $20 a short ton, duty paid, at tidewater."

I am at a loss to understand why Mr. Fay takes a shy at the mines of blanket formation. He quotes L. W. Currier, erroneously attributing the passage to Stuart Weller. Currier states in the same chapter that the greater time spent in field work for the Illinois State Geological Survey Bulletin No. 41 was in 1917. It is a matter of widest common knowledge that since that year a bedding deposit of great extent has been developed. Eighty-five thousand tons have been shipped to date, and substantial shipments are still being made. You say in the editorial referred to, "The fluorite is associated with a far larger bulk of calcite, which forms the mass of the fissure veins in question, and with a smaller and sporadic amount of lead and zinc sulphides, which, however, often occur in commercial quantities." The material of the bedding deposit carried almost no calcite, is very low in silica, and contains no zinc or lead. The deposit is developed from its contour-like outcrop, half way down the hill, on the east and south sides of the mesa, inward as far as the property line. This coincides with the contour passing around the brow of the hill. Approximately six-sevenths of the bed in which the fluorspar lies is beyond property boundary line at a depth of from 80 to 100 ft. below the gently sloping plateau which is the top of the mesa. That property awaits equipment for production. Is it fair to the owners of this unequipped bedding deposit that you publish that broadly condemning statement in regard to bedding deposits in general? It is the only quotation taken from Bulletin 41 and it is the only obsolete matter in that valuable work.

Mr. Fay mentions the 221 mines and prospects in Kentucky in 1907 that had the "enormous orebodies" as well as the "200 million tons of ore," and he lists but nine present-day Kentucky producers. After two decades, during which the price rose from $5 to $18 (a seven-year average), there are now only nine survivors to answer the rollcall out of the whole merry company of the original 221. Were they drowned in the rising tide of prices? Is it to be inferred that were the price now say $30 there would be no survivors? Since they had so much ore (the records show only 637,617 tons total production from 1902 up to the end of 1924 for Kentucky), were they overwhelmed with prosperity like the horse that got his nose in the grain bin and foundered? Well, hardly.

Elizabethtown, Ill. MARTIN SCHWERIN.

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

AMERICAN METAL CO. not affected by Daugherty-Miller trial—Supreme Court denies A.S.&R. Co. review of Carson patent case—Carson-Anaconda suit in progress.

Bunker Hill & Sullivan developing property near Sudbury—Lower-grade ore being treated at Kirkland Lake and Porcupine—Crown Reserve reorganized.

Hammon Consolidated Goldfields operating three dredges at Nome, Alaska; thawing ground with cold water.

Gold thefts at Selby smelter—Ocean water successfully used in flotation process at Wrigley mine—Alta Merger surface plant destroyed by fire.

Rand working costs decline—Complex ores, Sudbury, Ontario, under development—Manitoba forms Chamber of Mines—Tariff Commission asked to increase duty on pig iron, magnesite, and tungsten.

East Geduld Mines, Ltd., organized to develop property through and adjacent to the Geduld Proprietary—Russo-Asiatic still under control of Soviet.

Commerce Mining plans large power development in Oklahoma—South African capital enters Joplin-Miami district.

Callahan Zinc-Lead completes mill—Old Snowstorm mine reopened—Wolf Tongue ships tungsten concentrates to McKeesport, Pa.

Carson Patent Litigation at Butte

Siemens Used Side-Charging for Iron Ore in 1866—Also Used at Copper Cliff, Canada

THE suit of the Carson Investment Co. against the Anaconda Copper Mining Co. was opened on Oct. 1, 1926, before Judge George M. Bourquin in the federal court at Butte, Mont. The issue rests upon an alleged infringement of the Carson reverberatory patents by Anaconda. Back of this contention looms the possibility of the recovery of large sums of money if the decision is favorable to the plaintiff company. This is one of a series of actions by George C. Carson and his attorney, John W. Miller, of San Francisco, and the Carson Investment Co., which subsequently acquired the Carson patents. First was the Afterthought case, which was won by Carson but yielded only a dollar in damages. Next came the Tacoma smelter case, which was won by A.S.&R. Co., but subsequently this decision was reversed by the appellate court. Next was an action against the Garfield smelter in Utah, which was discontinued through technicalities. The present Anaconda case is apparently to be thoroughly fought out, and as a consequence is of considerable interest to the copper industry.

The plaintiff's case was presented during the forenoon. This involved the presentation of copies of the patents and other documents. Frederick Laist, metallurgical manager of Anaconda, was called to the stand by the plaintiff and in response to questions stated that Anaconda is and has been employing side-charging on its reverberatories. D. A. Usina, general patent attorney for Anaconda, was likewise called to the stand, and plaintiff's counsel endeavored to secure from him an admission that Anaconda was a party to the A.S.&R. company's case and should therefore be bound by the decision already obtained; but Judge Bourquin ruled otherwise, and, after exhibiting a model of Carson's side-charging furnace, the plaintiff's case was closed.

Frederick Laist was the first witness for the defense, and his testimony occupied the remainder of the afternoon and part of Saturday. Many charts and exhibits were introduced by the defendant. Laist's testimony opposed the view that Anaconda had adopted Carson's patents and maintained that side-charging had been invented by William Siemens in 1866 for use in iron-ore reduction. A reverberatory patterned after Siemens had been constructed and operated for seven months successfully. Further testimony was presented to show that elimination of the corrosion of the side walls of the reverberatory, one of the special features claimed by the Carson patents, is not dependent upon side-charging, but can be prevented by temperature regulation and control of other conditions, even to the extent of preventing it in center-charged furnaces. Laist stated that in 1914 Anaconda had installed side-charging furnaces with coal-dust firing after the general design of furnaces in use at Copper Cliff, Canada. Anaconda's furnaces made use of a "dry hearth" and were without a deep "bath" in the smelting zone of the furnace. Continuous skimming in place of periodic skimming is employed.

An attempt on the part of Anaconda's counsel to introduce testimony on the differences between blast furnaces and reverberatories was ruled out by the court. On cross-examination by Miller, plaintiff's counsel, Laist explained the handling of furnaces used by Anaconda in the interval 1902 to 1914. He stated in response to queries about the use of center-charging furnaces that had the engineers known what they have since learned about center-charging the change to side-charging might not have been necessary. Following the completion of cross-examination, A. A. Olson, counsel for Anaconda, introduced correspondence and telegrams showing that both Miller and Carson had been invited to inspect the Siemens furnace erected at the Anaconda plant.

C. R. Wraith was the next witness for Anaconda. He identified and described large models of different types of reverberatory furnaces used at the Anaconda reduction works. Judge Bourquin hastened the progress of the case and objected at times to what he considered unnecessary detail and extended discussions of furnaces and smelting methods.

For the second time during the trial of the suit of the Carson Investment Co. against the Anaconda Copper Mining Co., the defense has gone to the record of the plaintiff for proof to sustain its position that the Carson inven-

tion has not been infringed upon. Defense called upon Attorney Miller, counsel for Carson, and obtained from him the admission that in his brief before the U. S. Circuit Court of Appeals he had stated "where the smelting charge did not completely cover the sidewalls of the furnace this did not realize the Carson invention."

In the matter of the Siemens furnace, which was built to demonstrate the practicability of this invention in copper reduction, the defense offered the testimony of five witnesses who had worked on the furnace.

Frederick Laist was recalled to the witness stand and explained that the Anaconda company had first used the side-feeding method after seeing it in use at the Copper Cliff plant of the Canadian Copper Co.

Dr. James O. Handy, metallurgist of Pittsburgh, was on the stand and gave the history of the Carson patents and that of the Siemens patent, which dated from 1866. and which it is claimed ante-dated the Carson patent.

Old Snowstorm Mine Reopened

The Oregon-Idaho Mining & Development Co., which has a sub-lease on the old Snowstorm mine, Mullan, Idaho, has recently completed a flotation mill of 100 tons' capacity. Returns from the first two shipments of concentrate were highly satisfactory, the second car of 43 tons carrying 48.75 oz. in silver per ton and 38.45 per cent copper, from a mill feed that averaged about 5 oz. in silver and 2 per cent copper. The mill is situated near the portal of No. 3 tunnel at a high elevation, and a mile and a half from the railroad. A 2-inch pipe conveys the flotation slime to settling tanks near the railroad tracks from which the moisture is further reduced by filtration to condition for shipment. The Snowstorm mine was abandoned many years ago, the old mill dismantled and all equipment at the mine removed. A year or more ago leasers took hold of the mine and organized the Snowstorm Leasing Co. They soon found that the ore was too low-grade to ship crude. Being unable to provide a mill, negotiations were opened with Clarence Thom, metallurgist and ore-dressing engineer, to devise a milling process. This was successfully worked out and Mr. Thom thereupon took over the Snowstorm under sublease, organizing the Oregon-Idaho company.

Gold Road Mine Reopened

The mill of the Stemwinder Company, Oatman, Ariz., is reported to be running smoothly. This company was formerly operating the Tom Reed under lease, but since the cancellation of the lease contract it has made arrangements to purchase the old Gold Road mine of the U. S. Smelting, Refining & Mining Co. The material at present going through the mill is being taken from the tailing pit and dumps preparatory to the extraction of ore from the mine. Within a short time it is expected that operations in the Line Road tunnel will be under way, and ore will be coming from that point to the mill. The "glory hole" shaft is soon to be unwatered.

Callahan Zinc-Lead Completes Flotation Mill

The Callahan Zinc-Lead Co., Wallace, Idaho, will soon re-enter the list of producers. Since suspending production at the Callahan mine three years ago, the company has been engaged in developing the Galena property near Wallace and constructing a mill, which will begin operations about the middle of October. The mill is a flotation unit with a rated capacity of 150 tons per day, which may be increased with slight change to 200 tons if desired. The ore is lead-silver. Work underground was suspended while the mill was being constructed, but has now been resumed in preparation for steady production, and development plans will be carried out which are expected to make important additions to the ore reserves. With the Galena mill in operation, attention will be turned to remodeling the old Callahan mill, which means the discarding of jigs and tables and making it exclusively a flotation plant. Zinc was the chief product at the Callahan mine, and the suspension of production was due to the low price of that metal, although the ore had been practically exhausted on the deeper levels. However, above the 600 level there is quite a large tonnage that can be profitably mined at this time with more modern milling facilities.

Review of Carson Patent Case Denied A. S. & R. Co.

The U. S. Supreme Court has denied American Smelting & Refining Co. a review of the patent infringement judgment won by George Campbell Carson. The company charged that Carson, after winning his suit, attempted to substitute the Carson Investment Co. as recipient of the proceeds from the accounting ordered by the court. It also charged that the title to the two blast-furnace patents in question was not in the hands of Carson, in whose name the suit was brought.

American Metal Co. Not Affected by Daugherty-Miller Trial

C. M. Loeb, president of the American Metal Co. Ltd., has issued the following statement:

"The termination of the Daugherty-Miller trial makes this an appropriate time to correct mistaken impressions that seem to have arisen in regard to the American Metal Co., and we therefore desire to point out that the company has at no time been directly or indirectly concerned in this case.

"Following the entrance of this country into the war, we turned over to the Alien Property Custodian the shares which had been deposited with us, according to our records, for account of Germans. The transfer by us of this minority interest was in some press accounts, through misunderstanding of the facts, erroneously referred to as the taking over of the company or its assets by the Alien Property Custodian.

"In December, 1919, these shares were sold for cash by the Alien Property Custodian at public auction to a syndicate headed by Charles D. Barney & Co., bankers, thereby eliminating all German interest. The proceeds of the sale were, in September 1921, without reference to this company, released by the Alien Property Custodian to European claimants, and it is this release which was the subject of the recent trial. The American Metal Co. and its assets are neither directly nor indirectly involved, and the matter does not affect the company or anyone connected with it."

Mono Mining Makes Substantial Shipment

The Mono Mining Co., Sweetwater, Nev., operating a silver mine just over the Nevada state line in California, a few miles from Sweetwater, recently made a shipment of precipitates which was estimated to contain 23,000 oz. of silver. This represented the cleanup of two weeks' operation of its mill, which is treating 75 tons of ore per day. Reports indicate that practically all ore now being milled is being selected from old surface dumps and underground fills, which are estimated to contain 30,000 tons which will average 25 to 30 oz. silver per ton. Mine development is being continued from both the No. 2 and the No. 3 tunnel levels and ore of excellent grade is being blocked out in several places. As soon as cold weather and winter snows interfere with selection of dump ore, stoping will be started.

Shattuck-Denn Installs New Compressor

The Shattuck-Denn Mining Co., Bisbee, Ariz., has started the installation of a 2,000-ft. compressor at the Denn shaft, which will aid in enlarging and extending the development work being conducted at the workings. The development campaign includes the sinking of the Denn shaft from the 1,800 to the 2,000-ft. level, and the driving of approximately 400 ft. of driving in order to cut the high-grade encountered on the 1,800-level near the Junction side lines.

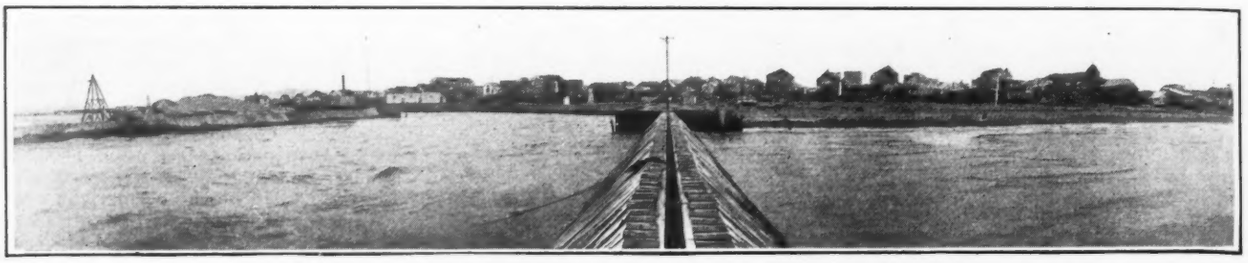
Wenden Copper Accepts Shaft

The Wenden Copper Mining Co., Wenden, Ariz., has accepted the three-compartment Barkdoll shaft 1,000 ft. deep, just completed on the company's property by Contractor Buchanan, and will at once let an additional contract for about 2,000 ft. of laterals and drifts.

It is said that ore of milling value was encountered in the shaft from the 540-ft. level down to the present depth.

Idaho Placer Claims Sold

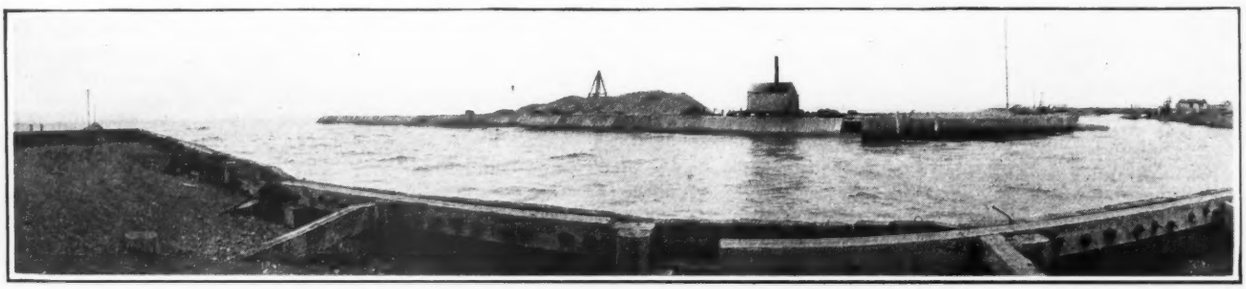
Wyoming purchasers of placer ground, Lucille, Idaho, on the Salmon River, are preparing to work during the winter. E. W. Butcher sold his claims to them for a reported consideration of $20,000 of which the first payment was $1,500. The placers are in the Big Nugget zone, where large nuggets are said to have been found.



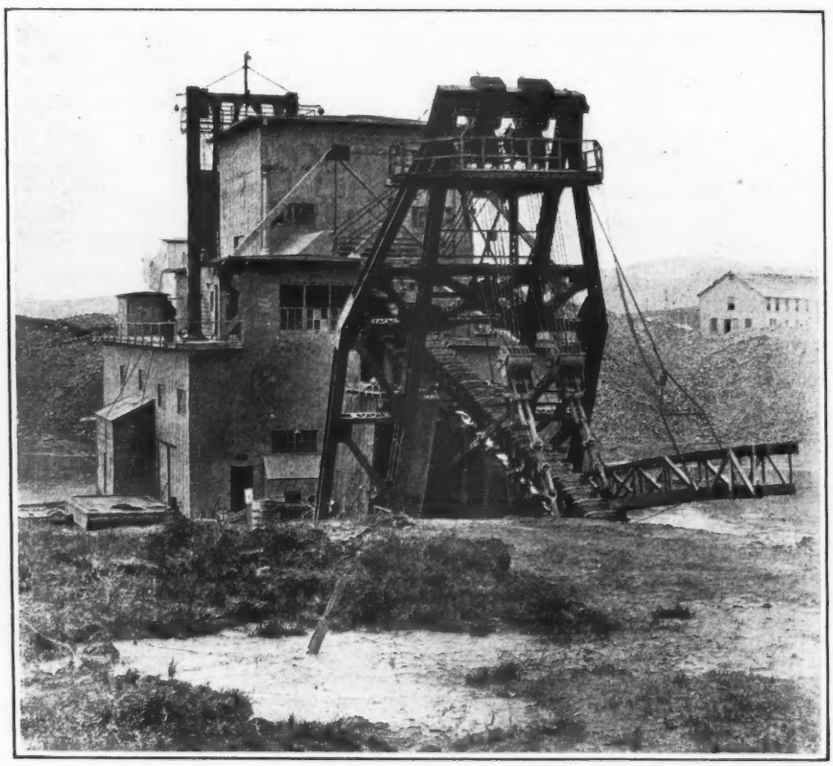
Nome as seen from the sea. Snake River jetties in foreground

Gold Dredging at Nome

The accompanying illustrations of the operations of the Hammon Consolidated Gold Fields, Nome, Alaska, were sent to the *Mining Journal* by George L. Holmes, of San Francisco. The property is controlled by the U. S. Smelting, Refining & Mining Co., and is under the management of O. J. Egleston. Three Yuba dredges are being operated at Nome on the third beach line and one dredge is working on the Snake River. Thawing is the critical factor as well as the short working season of about five months duration each year. To thaw the ground well in advance of dredging operations a sufficient area for a season's operation is staked out and drilled by Keystone drills at 16-ft. centers. The holes are drilled during the cold season and each is equipped with 1¼-in. double extra strong pipe through which cold water is introduced and circulated. Water-supply pipes are distributed over the surface and supply the vertical pipes. The ground is thoroughly thawed. Keystone drills, to facilitate movement, are provided with wide wheels, 36-in. face on the rear wheels, which are carried on long axles, giving a 15-ft. over-all spread. Tractors are used to haul the Keystones over the worst ground. The company employs 155 men, which includes ditch tenders, drillers, and dredge operators.



Mouth of Snake River, showing jetties, Nome, Alaska



Type of Yuba gold dredge in operation at Nome

Gold Thefts at Selby Smelter

Wide circulation has been given in San Francisco papers to a story about large thefts of gold at the Selby smelter of the A.S.&R. Co. near Martinez, Calif. The newspaper account is greatly exaggerated. The facts are as follows: Last December $1,000 worth of gold was deposited in a San Francisco office. As the gold was evidently parted gold, the management of the Selby plant was notified and efforts were made to trace the gold to its source. The result of the investigation was the discovery of the theft of another lot of gold to the value of $1,350 during the previous year. Both lots were evidently taken in small amounts from time to time. An investigation is now being made by State Mineralogist Root, who is enforcing the California high-grade law.

Wolf Tongue Ships Tungsten Concentrates

Fifty-five tons of tungsten concentrates was shipped Sept. 28 by the Wolf Tongue Mining & Milling Co. to the parent company, the Firth-Sterling Steel Co. of McKeesport, Pa. The shipment consisted of 900 sacks. The concentrates represent the clean-up of the summer's run of the Wolf Tongue mill at Nederland, Colo., 20 miles west of Boulder. A carload shipment of low-grade concentrates was made earlier in September. Most of the ore comes from the Cold Spring mine, in the Nederland section.

Lewis J. Firth, president of the Firth-Sterling Steel Co., is leaving for the East after spending six weeks in the field. He has authorized William Loach, manager of the Wolf Tongue company, to proceed with winter work at the Cold Spring mine to accumulate a supply of ore for milling next summer. This insures employment of from fifteen to twenty miners throughout the winter. Numerous leasers will also continue work on this and other properties.

Thawing dredging ground at Nome. A network of pipes supplies water to vertical pipes which are placed in drill holes

Washington News

By PAUL WOOTON

Tariff Commission Asked for Increased Duty on Pig Iron, Magnesite and Tungsten

An elaborate study of the pig iron situation has been completed by the staff of the U. S. Tariff Commission. All of the documents now are in the hands of the members of the commission. The investigation is being made to determine whether or not the commission should recommend an increase in the pig iron duty. As the commission has many other matters to consider the probabilities are that the report will not be ready to present to the President much before the first of the year.

Magnesite Industry Wants Higher Duty

More than half of the caustic magnesite being used in the country is being supplied by imported material. The domestic industry is being driven nearer and nearer the wall. The territory served by the importers is being pushed steadily westward. Foreign magnesite now is competing successfully as far west as Cincinnati. As the volume of domestic production is forced down the unit cost of production rises. The amount of domestic magnesite moving to New York for grinding is now at a rate less than 15,000 tons annually.

Domestic producers contend that the only hope in the situation is that the Tariff Commission soon will act favorably on their application for a fifty per cent increase in the rate of duty.

Fifty per Cent Increase in Duty on Tungsten Asked

An application for a fifty per cent increase in the duty on tungsten has been filed with the U. S. Tariff Commission by H. S. Predmore, of No. 3 Peck Slip, N. Y. A previous application for the full amount of the duty allowed by the flexible provisions of the tariff act was filed May 15, 1925, by the Madison Mining Corporation, of Morristown, N. J. Since two applications have been filed, it is possible that the Tariff Commission may decide to investigate the matter. It is known that the commission has been keeping in close touch with the tungsten situation.

The present duty on tungsten ore and concentrates is 45c. per lb. W, or $7.14 per unit of WO_3. Tungsten specialists in Washington expect the import movement to continue, as it is their understanding that the speculative stocks in the country are about exhausted. This does not mean, however, that the stocks of consuming interests are particularly low. In fact, there is positive information that no shortage is threatened. It also is noted that the higher prices for tungsten which have prevailed since March, 1925, have stimulated research on molybdenum and other substitutes.

Mr. Predmore says that our tungsten resources should be developed so that American consumers will not be at the mercy of the Chinese, who dominate the situation. He also advocates higher duties on all the ferro-alloys.

Treasure Hill Reports New Ore Discovery

It is reported that a new ore discovery has been made in one of the Treasure Hill mines, Hamilton, Nev. A large central area is under exploration by Joralemon, Hamilton and Dawson, mining engineers of San Francisco, and a close study of the mineralization and faulting has been made by them. The new ore is said to have been opened on the footwall side of a main fissure which traverses the mineralized portion of the Hill; or on the opposite side from the early-day orebodies, which were on the hanging-wall side.

The district has been without production for many years, although there has been some development carried on in various parts of the district. The orebodies occur as large replacement chambers in limestone, or as flat deposits along the bedding planes. As an indication of what could be expected if ore similar to the early-day chambers were found, old reports show that one lot of 22 tons from the Eberhart mine netted over $95,000. The present option holders believe there are faulted segments along the main ore channel which have never been prospected.

Hecla Mining Adds 4,000-Cu.Ft. Compressor

Ingersoll-Rand has just shipped to the Hecla Mining Co., Wallace, Idaho, a 650-hp. synchronous-motor direct-driven air compressor of 4,000 cu.ft. capacity. The addition of this machinery is part of the expansion program now being carried on by the Hecla company.

South African Capital Enters Joplin-Miami District

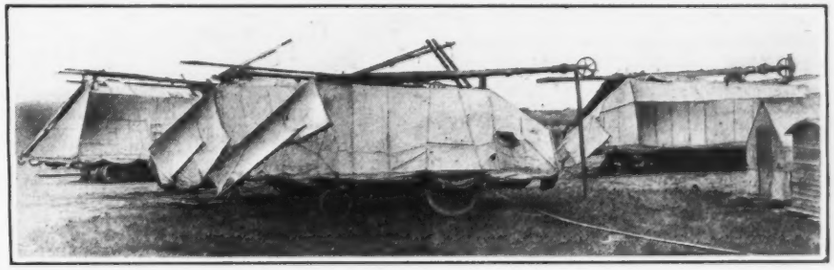
The Consolidated Gold Fields of South Africa has entered the Joplin-Miami district, through its subsidiary, the Goldfields American Development Co.

A drilling campaign has been started under the direction of F. S. Naething and Victor Rakowsky, of Joplin. Twenty-five drill rigs already are in operation in the Picher, Waco and Oronogo sections of the district. Work in Missouri is to be for the account of the recently organized Missouri Mining Co., and in Kansas and Oklahoma for the Tri-State Zinc Co., Inc., of Delaware. Offices have been established at Third and Wall streets, Joplin, and M. H. Loveman, of New York, with A. J. Klamt, will be in charge of the field activities.

Commerce Mining Plans Huge Power Development

A possibility that electric zinc smelting may be tried in the Joplin-Miami district a few years hence is suggested by the recent permit asked for and given to James F. Robinson, of Miami, Okla., head of the Commerce Mining & Royalty Co., for a $24,000,000 dam and 274,000 horsepower project in Grand River. The permit was granted by the Oklahoma State Irrigation, Drainage and Reclamation Commission, on Oct. 5. The project is for four dams, creating reservoirs in Mayes, Delaware, Craig, Ottawa, Wagoner and Cherokee counties, with a total surface area of 60,000 acres. The permit was granted conditional upon one-fifth of the project being completed within two and one-half years, while the statutory time for the completion of the entire project is five years.

The Commerce Mining & Royalty Co. has holdings in the Joplin-Miami district estimated as worth $20,000,000, and is the only company with reserves unquestionably sufficient to operate ten or twelve years. At present the company is building a $1,500.000 power plant at Cardin, to develop 10,000 horsepower.



Keystone drills at Nome, Alaska, protected by canvas when not in operation

Toronto Letter

By Our Special Correspondent for Northern Ontario

Lake Shore Elects Same Directorate—Kirkland Lake Milling $15 Ore

The annual meeting of the Lake Shore Mines, of Kirkland, held a few days ago, was a purely routine affair. Although only a few shareholders were present, 80 per cent of the stock was represented at the meeting and the old Board of Directors was re-elected. The addition of a new tube mill has not only increased the mill tonnage to approximately 600 tons a day, but is also permitting finer grinding, which will result in increased extraction. Kirkland Lake ores, owing in large part to the presence of tellurides, are difficult to treat and it has been proven that fine grinding will give better extraction. While some of the mines have been combining this with flotation a good deal of experimental work must still be done in order to determine the best technical practice.

The mill of the Kirkland Lake Gold Mining Co., which started on October 1, is treating 125 tons daily, the grade being about $15 a ton. The fight for the control of the Beaver, which involves the control of the Kirkland Lake Gold, has quieted down since the issue of a writ by J. B. Tyrrell. However, the present Board of Directors, headed by F. L. Cuver, the president, is making a strong fight for re-election and has definitely announced itself as being in favor of a dividend to Beaver shareholders in the form of 1,000,000 shares of Kirkland Lake Gold stock, which means a distribution of approximately 50 per cent.

Crown Reserve Reorganized

The Crown Reserve property at Larder Lake was recently taken over by a new company known as the Crown Reserve Consolidated Mines, Ltd., with a capital of 3,000,000 shares of $1 par, of which 2,500,000 are ordinary shares and 500,000 preference shares. The preference shares carry a cumulative dividend of 8 per cent from Jan. 1, 1927, and share equally with the common stock in dividends above 8 per cent, up to but not exceeding an extra 2 per cent in any one year. Shares are redeemable at $1.25 and accrued dividend. Shareholders are being given an opportunity to subscribe to the preference shares, which carry a bonus of one share of common for each preferred share at 80c. a unit. If the company is able to raise any substantial amount of money by these means, it is proposed to diamond drill both the Larder Lake properties and also the claims which the company owns in Quebec.

Argonaut Increases Mill

The directors of the Argonaut Mines, Larder Lake, have decided to increase the mill capacity from 85 to 150 tons a day. There is a year's ore in sight for the enlarged mill and recent development on the 875 and 1,000-foot levels has given most encouraging results. The financial position of the company has shown considerable improvement, as all debts have now been paid and the company has sufficient money to pay for the extra mill equipment and leave a balance in cash on hand.

Diamond Drilling at Rouyn

At the Waite-Montgomery property, in Rouyn, diamond drilling has been started to prove up mineralized areas indicated by the magnetic and electrical surveys. The magnetic surveys indicated seven new areas on the Waite-Montgomery and the strongest of these indications were checked by electrical surveys. It is interesting to note the increased use of electrical prospecting devices. The overburden is heavy, which makes ordinary prospecting difficult and uncertain, but the high conductivity of the Rouyn ores is particularly favorable for electrical prospecting. During the past few months the Ontario Government has been carrying on electrical prospecting in the Red Lake district to determine the suitability of the method to this class of ore.

During the month of September, the mill of the Dome Mines, Porcupine, treated 46,400 tons of ore and recovered $324,774, an average of $7 a ton. This is an increase of about 25 cents a ton as compared with the previous month, but the tonnage was a little lower. The net production remained the same.

Bunker Hill & Sullivan Developing Sudbury Property

The Bunker Hill & Sullivan interests, which took over under option a large zinc property near Chelmsford in the Sudbury district of northern Ontario, conducted extensive diamond drilling operations until July last. The results were regarded as sufficiently encouraging to warrant underground development, which is now being actively pushed. A shaft has been put down to a depth of 200 ft., and will be continued to a depth of 400 ft., where lateral work will be undertaken. Should this work prove that the orebodies discovered by diamond drilling are of sufficient extent and value, mining operations will be conducted on an extensive scale. Work is under the direction of P. R. Bradley, formerly smelter superintendent with the Canadian Copper Co.

Porcupine and Kirkland Lake Treat Lower-Grade Ore

The ore reserves of the mines of the Porcupine and Kirkland Lake gold areas of northern Ontario have during the last two or three years been increased by hundreds of thousands of tons, by the profitable treatment of what was formerly classed as waste rock. This has been rendered possible by the reduction of operating costs, which in Porcupine are now down to an average of about $4 per ton. The principal factors in lessening the cost of operations are the lower price of material and supplies, a more abundant supply of electric power at a cheaper rate, the use of more modern machinery and greater efficiency on the part of the workers, many of whom have become shareholders of the operating companies.

London Letter

By W. A. Doman

Special Correspondent

East Geduld Mines, Ltd., Organized to Operate Property Adjoining Geduld Proprietary

London, Sept. 28.—Probably what is the last mining area to be leased on the Rand has now been granted to the Union Corporation. It consists of 2,640 claims and immediately adjoins the Geduld Proprietary Mines on the east. Negotiations have been in progress for several years, but the ideas of the Union Government and the finance houses interested could not be harmonized. On the last occasion on which the area was put up to tender three proposals were submitted, one by the Union Corporation, which was accepted; one by Lewis & Marks, and the third by Sir Joseph Robinson. In the natural course of things the lease should have fallen to the Union Corporation, which controls the Geduld Proprietary Mines, for no other finance house could work it so economically. When tenders were invited the capital to be expended was mentioned as £1,800,000. This is a large sum to find in dull times when there is pessimistic talk of the Rand approaching exhaustion. Under the arrangement by which the Union Corporation will work the ground the initial capital requirements will be small. A company is to be registered in the Transvaal with the title of East Geduld Mines, Ltd., having a capital of £350,000, of which £50,000 will be raised in fully paid shares, and 300,000 shares will have 2s. paid, leaving the balance of 18s. to be called up as and when required. Seeing that a large portion of the area can be developed through the Geduld Proprietary workings—and it is this fact which conduces to economy—the Union Corporation and the Geduld Proprietary will participate in the business on a "fifty-fifty" basis. Neither company will issue new shares, for each has money in the coffers, and neither company will allow the new arrangement to interfere with the continuance of the existing dividend policy. From the standpoint of consideration payable to the government, the East Geduld Mines will be on the most favored terms of any leased area on the Rand. In fact the terms are exceptional. There will be no delay in getting to work, for the Geduld Proprietary workings are right up to the boundary and ready to be extended. Had any other group of financiers secured the lease it would have been necessary to sink two vertical shafts, involving heavy expenditure before reaching the reef. The Geduld Proprietary values on the border give an indication of what may be found in the East Geduld, while good values have been proved in the Modderfontein East on the north and in the Springs Mines on the south. The new company will therefore start under most favorable auspices.

The tin market is a little less excited at the moment, but the lull is confi-

dently reported to be only temporary, as interested persons have been taking profits both in the metal and in mining companies' shares. Additional companies have been floated, though they will not add appreciably to the output for some time.

Two new discoveries have been made on the Rhodesian Congo Border Concession, in both of which copper and gold showings are favorable.

RUSSO-ASIATIC RETAINED BY SOVIET

I have heard it suggested, though I mention it with all reserve, that the Russo-Asiatic Consolidated will not get restoration of its concessions, as conditions governing the value of the chervonetz are so unfavorable. The chervonetz has to be bought at the price fixed by the Soviet Government, and as prices in Russia have risen considerably its purchasing power has greatly depreciated, making operations unprofitable.

Complex Ores Near Sudbury Nickel Under Development

Some time ago certain diamond drilling operations in the vicinity of the Sudbury (Canada) nickel formation revealed good showings of a complex ore carrying zinc, copper, lead, silver and gold. Since then the Treadwell-Yukon and the Primus Chemical have done $75,000 worth of drilling and have located at least two large mines and possibly more. Recently other interests have taken claims in the locality, and last week the International Nickel took about fifty. A large number of land options held by the Bunker Hill, the Treadwell-Yukon, and the Primus companies running from a small sum up to $100,000 for single 160-acre tracts were closed within the last two weeks, and preliminary work toward opening mines is now under way on a large scale.

Fire Destroys Merger Plant at Alta, Utah

Fire recently destroyed the surface plant of the Alta Merger Mines Co. at Alta, Utah, one of the landmarks of this old Utah camp. The hotel, snowsheds, shops, transformer house, and ore bins were burned in the conflagration, which occurred during a raging blizzard, accompanied by terrific lightning and thunder. Plans are being made to replace the buildings with a temporary plant so that operations during the winter may not have to be suspended.

Silver-Lead Ore in Eastern Ontario

Montreal capitalists have become interested in the mineral deposits of silver, lead, and feldspar recently discovered at Long Point, 15 miles north of Gananoque, Ontario, not far from the St. Lawrence River. They have taken a lease of 200 acres of land on the property of David Townsend and James Burns at that place. Men have been set to work, and already a vein has been found that gives bright promise of ore of a paying grade.

Johannesburg Letter

By John Watson

Special Correspondent

Rand Working Costs Decline—Pretoria Silver Reports New Tin Lode

Johannesburg, Aug. 31.—The monthly analysis of gold production, recently issued by the Transvaal Chamber of Mines, shows that the working cost per ton of ore milled for July was 18s. 6d. For the first seven months of 1926 working cost averaged 19s. and for the corresponding period of 1925 the figure was 19s. 4d. J. H. Curle, author of "The Gold Mines of the World," and formerly mining editor of *The Star*, Johannesburg, has recently contributed an article to the *Mining and Industrial Magazine*. Quoting from the recent report of the Government mining engineer, he says there are forty-three gold mines working on the Rand today, putting into circulation forty millions of gold a year; but five years hence nineteen of these mines will be finished, in ten years thirty will be finished, and in fifteen years only six will remain. Mr. Curle considers that it would be to the interest of all concerned if the Rand mining costs could be got down to 15s. per ton, when 150,000,000 tons of ore, now rejected, would be brought within the pay zone. The present native ratio, one white man underground for every ten natives, he regards as a fetish. Mr. Curle does not favor night-shift work, but would have the mines worked from early morn (6 or 7 a.m.) till 10 or 11 p.m.

New Pretoria Silver Lead Co. reports on Aug. 26 that its prospector on its Waterberg block of claims, farm Rhenosterhoekspruit and Uitkijk, has just discovered a new tin lode, 3 ft. wide at the surface, which he has so far traced for a distance of 400 yd. His pannings give values of from 1 to 3 per cent of tin. The bismuth lodes also are opening up well. The No. 3 lode is over 5 ft. in width, and values throughout continue to be highly satisfactory.

The Union Department of Mines on Aug. 27 issued the following statement of mineral production, platinum being included for the first time:

	July	June
Gold	£3,656,481	£3,600,180
Silver	11,481	11,283
Osmiridium	8,134	3,719
Platinum	16,261	.....
Diamonds	884,651	799,401
Coal	359,116	346,195
Copper	33,301	51,853
Tin	12,901	22,765
Other minerals	26,977	36,360
Total value	£5,009,903	£4,871,684

On the Johannesburg Stock Exchange during the last week business increased as the week progressed. There has been a better demand for gold shares at advancing prices. London business was quiet early in the week, but improved on Thursday and Friday. Sub-Nigels were again largely dealt in. Their price fluctuated, but on Saturday the closing sale price was 55s. 6d. Geduld's were a big market, and their price improved during the week from 78s. 6d. to 83s. 3d. Rose Deeps were largely dealt in at 8s. to 9s. 6d. on a rumor that the mine has acquired more ground. Transvaal Platinum, 5s. shares, which went up to about £5 three years ago, were sold last week down to 3s. 6d. Pretoria Silvers have risen during the week from 3s. 6d. to 4s. 8d., with large business.

Chamber of Mines Formed in Manitoba

A group of Manitoba business men has organized at Winnipeg the Manitoba Chamber of Mines with the object of fostering the growth and development of mining and attracting and assisting prospectors. All parts of the province will be represented on the advisory board. The chief function of the chamber will be to gather reliable information for distribution to those interested in mining.

Ocean Water Successfully Used for Flotation at Wrigley Mine

The Wrigley mines on Catalina Island, near Los Angeles, Calif., are shipping 200 tons of zinc concentrate and about 200 tons of lead concentrate per month. The success of these mines has encouraged others, until there are now about twenty-five active prospects, some of which may turn out to be real mines. The properties now in operation have paid from the start.

Owing to the scarcity of fresh water, it has been necessary to use sea water in the flotation mills. Dire results were threatened by flotation experts, who claimed that the salt in the water would prevent "foaming." Such, however, was not the case, and satisfactory results were obtained. An explanation of this is advanced by D. M. Renton, general superintendent, who states that the chemists at the mill found that the water used came from the kelp beds and contained enough iodine and potassium, derived from vegetal and animal matter, to effect the proper chemical solution needed to "foam" the flotation pulp.

RESULT OF PAINTER'S MISHAP INTERESTING IF TRUE

One of those providential accidents that help along chemical investigations at times occurred at the White's Landing mill (Catalina) a short time ago. A clumsy painter endeavoring to paint the new tramway recently completed above the ore bins, spilled the contents of his paint bucket onto the ore, and was roundly "cussed" for his awkwardness. On checking up the percentage of recovery from that bin of ore it was found that it had increased from the average of 36 per cent to 48 per cent, an estimated gain of $110 on the day's run of the mill. Upon investigation it was discovered that the kerosene and linseed oil in the paint precipitated the iron pyrites which up to that time had been troublesome. It is estimated that the accidental spilling of the bucket of paint will increase the net annual profits of the White's Landing mill approximately $50,000.

Situation at the Mines

By Albert H. Fay
Assistant Editor

THE PUBLICATION of the report of the Royal Commission on Indian Currency has had a decided effect upon the American silver market, and it causes no little anxiety on the part of the Western silver producers. The Canadian silver producers are even in a worse plight, as the majority of them produce silver only, with no byproducts of lead, zinc, or copper. Since a large part of the silver production in the United States is a byproduct of lead and copper

Average Prices April, 1926, to September, 1926

	In Cents			
	Copper	Lead	Zinc	Silver
Average, 1925	14.042	9.020	7.622	69.065
April	13.706	7.971	7.001	64.409
May	13.599	7.751	6.821	65.075
June	14.656	8.033	7.112	65.481
July	13.924	8.499	7.411	64.793
August	14.174	8.908	7.376	62.380
September	14.062	8.786	7.413	60.580

smelters, this class of mine is not so badly hurt. In cases where zinc is also a byproduct, under present metallurgical methods, it in a measure offsets the loss due to the lower price of silver. The copper situation is not improving as rapidly as the producers would like. Much depends upon the restoration of European markets.

Copper—Development at the Noranda mine, in Canada, continues, with 400 men employed on smelter construction and mine development. Smelter costs are estimated at $5 per ton. The Rhodesian Congo Border Concession, Ltd., a British company in which Americans are interested, is to open another important African copper area adjoining Katanga. The Anaconda Copper Mining Co. continues its production of about 17,000,000 lb. of copper per month, all of which is consumed at the company's manufacturing plants at Great Falls, Mont. Utah Copper is producing at the rate of 18,000,000 lb. per month. The same company has just completed a new camp at Bingham to relieve the crowded living quarters for its employees. More men are employed at Bingham in and around the mines than at any other time in the history of the camp.

In Michigan the Seneca Copper has completed its construction program and has 300 men on its payroll. September production of refined copper in the Michigan district was estimated to be 14,600,000 lb., an increase of half a million pounds over the total for August. Calumet & Hecla output is estimated at 9,000,000 lb., Ahmeek and the Osceola lode branches showing an increase. Mohawk produced 1,450,000 lb.; Copper Range, 1,750,000; Quincy, 1,000,000; Seneca, 600,000; Isle Royale, 800,000. Metal business at the smelters is good, deliveries both by water and rail being fully equal to current production. After a lapse of six years the Trimountain, of Copper Range Consolidated, is beginning to return a profit, chiefly due to increased production, which is around 200,000 lb. a month.

There continues to be a slight shortage of labor at the Michigan copper mines and also a shortage in certain districts in New Mexico. The Arizona mines continue production on a normal basis, while at Cananea (Sonora, Mexico), a new deep shaft is planned for the Democrata mine.

Lead-Silver—The Coeur d'Alene district, Idaho, is experiencing its greatest year of construction work in the way of enlarging mills, construction of new mills, and the development of ore reserves. When the present program is completed there will be eighteen mills in operation, treating about 6,000 tons of ore daily. The Idaho United Metals Co. has acquired a number of properties and combined them into one operating group. Treadwell-Yukon has made a shipment of 3,000 tons of lead-silver ore from Mayo, Yukon Territory, to the smelter at Kellogg, Idaho, with other shipments following before the close of the transportation season. In Utah shipments continue from the Park City district at the rate of about 7,000 tons per week. The Park-Utah Consolidated Mines Co. is now giving employment to about 1,100 men in and around its Park City mines, which include the Park Utah, Daly West, the Judge, and the Ontario. At Tintic a total of 232 carloads of ore and concentrate was sent to the smelters the last week in September, in comparison with 197 carloads the preceding week. The dividends paid by Utah metal mines are on a basis of about 10 per cent greater than in 1925, showing a healthy condition of the industry. In British Columbia the Consolidated Mining & Smelting Co. is handling about 14,000 tons of ore per week at its Trail smelter. There are about twenty-five mines in the vicinity that are making regular and substantial shipments to the Trail smelter.

Zinc—The weekly production in the Joplin-Miami district is 16,000 tons of zinc concentrate and 2,500 tons of lead concentrate, with 176 mills operating. A number of the old, abandoned mines are being redrilled and opening up new deposits at lower depths. Several new mills are being installed and old ones are enlarged. A number of mills are operating on old tailings dumps and are producing approximately 400 tons of zinc concentrate per week.

The new mill of the Callahan Zinc-Lead Co., at Wallace, Idaho, is reported as ready for operation on Oct. 15. Possibilities of zinc production are reflected in the great activity on Pine Creek, Idaho, where it is estimated that 500 men are employed. Two mills, the Constitution and Highland-Surprise, are making zinc concentrate and also considerable lead. The Sidney, will soon double its output of crude ore, while the Douglas has suddenly advanced to a position of importance as a shipper of zinc-lead ore. This activity is due largely to anticipation of results to be obtained from the electrolytic zinc plant at Kellogg.

The Wrigley mine on Santa Catalina Island, near Los Angeles, is shipping about 200 tons of zinc concentrate per month to French and Belgian smelters. The same property is also shipping about 200 tons of lead-silver concentrate to the Selby Works, at San Francisco.

Continued high prices for lead and zinc have resulted in arousing considerable interest in properties known to contain these ores in eastern Canada, and several mines are being re-explored. In Nova Scotia shaft sinking is now in progress on the Stirling zinc-lead prospect, in Cape Breton, and work is being done on the old Smithfield lead mine near Truro. In Quebec the British Metals Corporation has made improvements in its mine and mill at Notre Dame des Anges, resulting in a considerably increased output, and exploration is going forward on the Federal Zinc & Lead Co.'s mine in Gaspe. In Ontario lead production is being increased at Galetta and exploration is being carried on at Frontenac near Kingston, as well as Lake Timiskaming, Sudbury, and Renfrew.

Gold—The Transvaal mines, after a period of forty years of operation, have set new monthly gold-production records during the year, and the annual production at present is greater than it has been at any time in the past. Hydraulic mining in California is to be resumed, pending the construction of enormous dams for the impounding of the débris. Three dredges are operating at Nome, Alaska, where the ground is being thawed by cold water. Tonopah production is normal at the rate of about $170,000 per month. The White Caps mine, Manhattan, Nev., is reported as opening good ore on the 1,310 level. Howey Gold Mines, Ltd., plans to develop Red Lake claims, although the Dome Mines, Ltd., did not exercise certain options thereon. The Wright-Hargreaves company is expanding its development program, and a number of new mills are under construction. Kirkland Lake Gold resumed milling operations on Oct. 1, after an extended shut-down. Ontario gold production sets a new record, being $20,750,000 during the first eight months of the year.

Iron—September shipments of iron ore from the Lake ports was approximately 9,700,000 tons. The best previous record was in September, 1916, with 9,600,786 tons. Shipments to Oct. 1 of this year are 45,300,000 tons, or an increase of more than 2,000,000 tons over last year. Ford's new mine on the Marquette range, the Blueberry, is now sinking a 1,000-ft. shaft. It will be several months before actual production can be obtained. Witherbee, Sherman & Co., Port Henry, N. Y., have completed extensive additions to their plant and are now operating at full capacity. The shaft cave-in at the Pabst iron mine in Michigan, killing three men and imprisoning forty-three others, all of whom were safely rescued after five days, will delay production at this large mine.

People You Should Know About

Alfred James recently arrived in New York.

W. H. Blackburn of San Francisco, Calif., is at Tybo, Nev.

Waldemar Lindgren, is in Butte, Mont., on professional business.

Courtenay De Kalb was in London early in October on his way to Paris.

George H. Garrey, mining engineer and geologist, Philadelphia, is in San Francisco.

Donald M. Liddell has returned from an extensive trip to Europe. His family accompanied him.

Nelson W. Graham, late of Modder East, recently left Johannesburg, with his wife, for Trinidad.

Dr. Walter Harvey Weed, geologist, is making an examination of properties in the vicinity of Butte.

L. S. Cates, manager and vice-president of the Utah Copper Co., has landed in New York from a trip abroad.

W. J. Gau, consulting engineer to the Bailey group of mines, and Mrs. Gau, have returned from England to South Africa.

T. A. Rickard read a paper on "The Later Argonauts" before the Institution of Mining and Metallurgy in London on Oct. 14.

Bradley Stoughton, formerly secretary of the A.I.M.E. and now on the metallurgical staff at Lehigh University, recently visited Butte.

George J. Young, associate editor of the *Engineering and Mining Journal,* is making an inspection of Montana properties in behalf of his paper.

Jerome J. Day, of Wallace, Idaho, president of the Tamarack & Custer Consolidated Mining Co., and **Axel P. Ramstedt,** comptroller for the Day interests, are in Pittsburgh.

Everett H. Pattison, superintendent for the Catalina Islands Co., of Avalon, Cal., was a recent visitor at Wallace, Idaho, where he formerly resided and where he still has mining interests.

Nicholas Liepner, managing director, and **J. Allan Woodburn,** consulting engineer, recently left Johannesburg on a visit to the property of the Northern Transvaal Copper Exploration, Ltd.

Arthur L. Flagg, manager and engineer for the Hope Metals Co., operating on Deer Creek, near Christmas, Ariz., has been in the East conferring with the company's officials at Providence, R. I.

John Daniell, mining engineer and geologist, recently opened an office in Los Angeles. He has lately been engaged in extended examinations of the asbestos deposits of Calaveras County, Calif.

H. S. Munroe, a member of the mining engineering staff of the American Metal Co., recently returned to this country after field work in South Africa. He is leaving soon for South America.

J. E. Warneche left Los Angeles recently to take charge of operations at the Cabrita mine, Santa Barbara, Mexico. Mr. Warneche is associated with the Southwestern Engineering Corporation.

Charles Labbe, formerly for some time with the Eureka Johnnie Company, is now acting as construction engineer on the new concentrating mill which is being erected at Clarkdale, Ariz., for the United Verde Copper Co.

Colonel William B. Thompson left New York on Oct. 3 with officials of the Texas Gulf Sulphur Co. for an inspection of the company's properties at

Colonel William B. Thompson

Gulf, Tex. From there he will go to Superior, Ariz., where he will spend most of the winter at his home at the edge of the desert.

F. L. Bosqui, an old resident of the Rand, is now there on a visit from America. He left Johannesburg, on Sept. 1, in company with **Kenneth L. Graham,** of the Corner House, on a visit to the Lydenburg district.

Thos. F. Keeley, of Chicago, president of the Gold Hunter Mines Co., has returned home after spending two weeks inspecting the Gold Hunter and other mining operations in which he is interested at Mullan, Idaho.

Walter J. Pentland has retired from the management of Amajac Mines Co. at Ixtlan del Rio, Nayarit, Mexico, and taken over the management of the Amatlan Mining Co. of Zacatecas, at Chalchihuites, Zacatecas, Mexico.

Henry M. Rives, secretary of the Nevada Mine Operators Association, has returned to Reno, Nev., from Denver, after attending the convention of the American Silver Producers Association, of which he is also secretary.

Sir Robert Kotzé, Government Engineer for the Union of South Africa, has resigned, after many years of efficient and honorable service. He was awarded the gold medal of the Institution of Mining and Metallurgy a few months ago.

Donald A. Callahan, of Wallace, Idaho, president of the Callahan Zinc-Lead Co., and **C. W. Newton,** of Wallace, general manager, will attend the annual meeting of the directors of the company, which will be held in New York on Oct. 18.

Homer A. Noble, petroleum geologist, is now associated with **W. Armstrong Price,** with offices at 912 Bankers Mortgage Building, Houston, Tex. Mr. Noble was formerly district geologist for the Marland Oil Co. of Mexico, Limon lease, Tampico district.

Gust Carlson, of Duluth, director of the Callahan Zinc-Lead Co., was in Wallace, Idaho, Oct. 1. From Wallace he went to British Columbia and thence to Kingman, Ariz. expecting to reach New York to attend the meeting of Callahan directors on Oct. 18.

Dr. James O. Handy, metallurgist of Pittsburgh, Pa.; **Henry D. Conant,** superintendent of the Calumet & Hecla mines, and **Charles Rees,** foreman of the Garfield (Utah) plant of the American Smelting & Refining Co., are in Butte as witnesses in the Carson vs. Anaconda lawsuit.

H. St. J. Somerset, metallurgical engineer and general superintendent of the Broken Hill Associated Smelters Proprietary, Ltd., at Port Pirie, South Australia, has been given the post of general manager of that company, with headquarters at Melbourne. He is succeeded as general superintendent by **O. H. Woodward,** who for some years has been second in command with the same company.

Tetsujiro Kubota, assistant manager of the Saganoseki smelter, at Oitaken, Japan, is in the United States to study copper-mining and smelting conditions. He was in New York the early part of October, and will travel extensively in the course of his research investigations. Readers of *Mining Journal* may recall that the stack of the Saganoseki smelter is one of the highest in the world. The plant is a property of the Kuhara Mining Co., Tokyo, Japan.

Obituary

Benjamin Dunlop, a pioneer of the Yukon, where he came in the rush of 1898, died recently in Vancouver at the age of fifty years. He remained in the Yukon until 1905, when he removed to Vancouver.

Harry L. Friberger died at his home in Eureka, Kan., on Sept. 2. He was born in Greenwood County, Kan., near Eureka, June 15, 1875. In early life he moved to Eureka with his parents, where he attended the Southern Kansas Academy for several years, later becoming interested in mining engineering In 1899 he went to the Mexicoto gold and copper mines, where he was engaged in metallurgy and mine supervision. Mr. Friberger had been a flotation engineer with the General Engineering Co. of Salt Lake City and formerly was engaged with many mining companies in the western part of the United States and in Mexico. For the last four years he had been with the San Francisco Mines of Mexico, La Novia mine and the Pittsburgh Veta Grande Mining Co. in Zacatecas.

Recent Technical Publications

Reviews, Abstracts, and References

Geology of Nickel-Copper Ores

Igneous Rocks of Sudbury and Their Relation to the Ore Deposits. By T. C. Phemister. Thirty-fourth Annual Report Ontario Department of Mines, Toronto. Vol. XXXIV, Pt. VIII. Obtainable on request.

The origin of the ores in Sudbury has been a long-standing problem, to whose study many geologists have contributed. Long accepted as the result of magmatic differentiation *in situ*, through gravitative settling from a norite sill, this origin has been repeatedly disproved; and Dr. Phemister adds another to the list of those who deny this origin. His conclusion closely follows that of Spurr, which coincided in many ways with that of Knight, and those of Howe and Bateman. The ores are one member of a magmatic sequence, the other members of which are igneous rocks.

The "norite" (gabbro) which forms the lower part of the Sudbury sill is regarded by Phemister as a slightly earlier and separate injection than the micropegmatite which forms the upper part, a conclusion first put forward by Dr. Phemister. There has perhaps been a little differentiation *in situ*, of the gabbro, but it has nothing to do with the ores or the micropegmatite, or the other igneous injections. The magmatic sequence, as Phemister enumerates it, was: "norite (gabbro), micropegmatite, granite, quartz-diorite, sulphides, all coming in succession from unexplored depths. Dr. Phemister omits the basic dikes later than the ore, described in several mines by Knight.

The chief point of difference with the view of Spurr is stated to be that since the ore-solution contained water, and accomplished considerable replacement, it should not be called "ore magma" but "hydrothermal solution": yet it is found that "there is abundant evidence that these hydrothermal solutions had a certain intrusive power." Here we have clearly a difference of names, and not of ideas; an unnecessary difference, as the following two quotations show: (1) "If it is proved that in the ore-forming agency, aqueous constituents were present to a marked degree, then the term 'magma' must be dropped and the phrase 'hydrothermal solution' substituted." (Page 52.) (2) "We know that the micropegmatite has been high in water and quartz, since these have traveled into the overlying sediments." (Page 26.) Therefore, the reader must conclude, if he obeys Dr. Phemister's mandate in the first quotation. that the micropegmatite was deposited from a "hydrothermal solution"—with which terminology Dr. Phemister would, of course, not agree. Habits of speech—well-accustomed phrases—are as hard to break as any other long-established habits, and stick in spite of common sense. The micropegmatite magma, Dr. Phemister shows, has accomplished much replacement of the adjacent sedimentary rocks. (Page 22.)

Another minor conclusion of Dr. Phemister's may be challenged—that the igneous silicate rocks "present a problem in petrogenesis which is independent of the problem of the ores. (Page 3.) Petrogenesis and metallogenesis are inextricable problems, as the reviewer and also Dr. Niggli have maintained, and in the present instance there is local proof, consisting in the occurrence of sulphide-bearing pegmatite as one phase of the ore-injection. Attention was called to this in the Creighton mine in a publication by the reviewer; and Dr. Phemister describes it for several other mines, agreeing with the reviewer that it constitutes a later phase of the ore. (Page 43.)

In general, the paper is a valuable addition to the already existing literature, the cumulative effect of which is to make clearer and clearer the nature of the Sudbury ores—a matter which needs thorough revision in existing textbooks. J. E. SPURR.

Californian Geology—U. S. Geological Survey Bulletin No. 768 is devoted to the "Geology and Oil Resources of the Puente Hills Region, Southern California," by Walter A. English, with a section on the "Chemical Character of the Oil," by Paul W. Prutzman. The bulletin comprises 110 pages, with several maps.

Tennessee — The thirty-first annual report of the "Mineral Resources of Tennessee," pp. 163, has been issued and is obtainable from the Division of Mines, Department of Labor, Nashville, Tenn. Most of the bulletin is devoted to coal, though there are sections on barytes, bauxite, copper, iron, limestone, manganese, mineral paints, phosphate, oil, and zinc.

Gas Formulas—"The Application of Kutter's Formula to Gases" is the title of a 10-page paper by F. Ernest Brackett, recently published by the American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City. The study is confined to fluid friction when the density throughout an air duct is practically constant.

Patents

Chlorination—No. 1,599,269. Sept. 7, 1926. E. A. Ashcroft, London, England. Raw lead-zinc sulphide ores are chlorinated with chlorine or chloride of sulphur, at a temperature of 600 to 700 deg. C., the sulphur expelled being condensed and recovered. The mixture of metallic chlorides produced is treated in the cold with a concentrated aqueous solution of zinc chloride to extract the soluble chlorides from the lead chloride. The last-named, with any silver chloride, is then electrolyzed in the fused state for the recovery of the metal or metals. Preferably, the electrolysis is effected in a multiple-couple electrolyzer.

Aerial Tramway—No. 1,602,271. Oct. 5, 1926. G. M. Kilcarr, New York City, assignor to Interstate Equipment Corporation, New York City. Design for a supporting structure constituting an intermediate station in an aërial tramway, the cars of which travel in an inverted position on the return run.

Refractory—No. 1,602,273. Oct. 5, 1926. F. C. F. le Coultre, Marseille, France, assignor to Société d'Etude des Agglomérés, Paris, France. Zircon ores are treated at a very high temperature in an electric furnace and then precipitated into a violent stream of cold water acidulated with 1/1,000 part of sulphuric acid.

Sulphur Recovery — No. 1,599,363. Sept. 7, 1926. Josef Jannek, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie A-G., Frankfort-on-the-Main, Germany. Sulphur is removed from masses containing it by passing superheated steam at high speed through the mass and separating the sulphur from the steam.

Converting Matte — No. 1,599,424. Sept. 14, 1926. Otto Lellep, Egypt, Pa., assignor to The International Nickel Co., New York City. Nickel or copper-nickel matte is treated in the molten state with a blast of air, additional heat being supplied to the reaction.

Drying Furnace—No. 1,599,467. Sept. 14, 1926. W. G. Graves, Cleveland, Ohio, assignor to the Grasselli Chemical Co., Cleveland. A multiple, closed-hearth drying and heating furnace, with revolving rabble arms.

Flotation Machines—No. 1,599,561. Sept. 14, 1926. A. B. Emery, Messina, Transvaal, South Africa. A flotation machine in which small streams of the pulp impinge against a baffle with sufficient violence to form the desired froth.

No. 1,601,860. Oct. 5, 1926. O. H. Johnson, Denver, Colo. Design for a pneumatic flotation cell.

Drill Bit—No. 1,599,781. Sept. 14, 1926. G. F. Nevin and John Goodland Jr., Butte, Mont. An apparatus for constricting the mouth of the central channel in a rock-drill bit.

Rock-Drill Valve — No. 1,599,816. Sept. 14, 1926. C. C. Hansen, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. Design for a rectangular slide valve for rock drills.

Core Drill—No. 1,600,073. Sept. 14, 1926. H. C. Smith, Whittier Calif. A rotary core barrel and drilling bit.

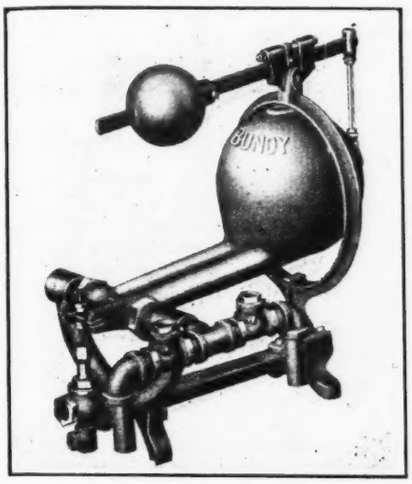
Cyanide Recovery — No. 1,600,228. Sept. 21, 1926. L. W. Heffner, East Norristown Township, and William Tiddy, Jeffersonville, Pa., assignors to Rainey-Wood Process Corporation, New York City. Gases containing ammonia and cyanides are treated with an absorbing medium to absorb the cyanides preferentially; the absorbed cyanides are then converted into prussian blue.

Fume Precipitation—No. 1,600,496. Sept. 21, 1926. C. H. Weiskopf, Hawthorne, Calif. Design for an electrical fume precipitator of the Cottrell type.

Gyratory Crusher — No. 1,600,780. Sept. 21, 1926. E. B. Symons, Hollywood, Calif., assignor to Symons Bros. Co., Bakersfield, Calif. Design for a gyratory crusher.

Ball Mill—No. 1,601,466. Sept. 28, 1926. Angelo Benna, Juneau, Alaska. Design for a ball mill.

New Machinery and Inventions



Designed for Simplicity

Troubles from leakage and binding at the trunnions in this trap have been reduced by the use of a liquid coupling, which together with a ground joint forms a self-forming packing.

Improved Steam Trap

Reduction in the number of parts and changes in design to eliminate packing and trunnion difficulties are among the improvements made to the line of steam traps manufactured by the Bundy Steam Trap Co., Nashua, N. H.

The bowl, pipes and elbows formed integrally are all in one casting, instead of five as formerly, a screw plug in the top of the bowl permitting access to the interior of the bowl for cleaning, etc.

To reduce the friction to the tilting motion as much as possible, the counterweight lever is suspended on a ball bearing, and the link between the bowl and the lever rocks on knife-edges in place of pins. The shock due to the bowl's tilting has been lessened by providing a cushion against which the lever attachment strikes at each tilting of the bowl. Another feature is the change made in the method of attaching the valve stem to the extensions of the bowl to facilitate adjustments.

The principle of operation and general design of the trap remains the same, the refinements just mentioned being made with a view to increasing the reliability and general utility of the trap. The trap is made in eight sizes ranging from ¾ to 3 in.

World's Largest Turbine

A steam turbine generator unit rated at 208,000 kw. or nearly 280,000 hp.—about three times as large as any of the giants in service today and nearly half again as large as any under construction anywhere in the world—is being manufactured by the General Electric Co. as the first unit for the world's newest and largest electric generating station, that of the State Line Generating Co. on the Lake Michigan shore, in Indiana.

The turbine-generator will be unique in many respects. Not only will it be the largest, but it will incorporate the largest 1800 r.p.m. generator ever constructed, it will be the first to use live steam for reheating, and it will be the first turbine-generator to generate current at 18,000 volts.

The State Line Generating Co. station, with a contemplated capacity of 1,000,000 kw. or about 1,335,000 hp., will be many times larger than any steam-operated electric plant now in existence. The plant itself marks a new era in power production, in that it will serve exclusively as a producer and wholesaler of electricity. It will produce electric energy for the interconnected power companies of the Chicago-Illinois-Indiana district, which was termed by the late Dr. C. P. Steinmetz as "the greatest pool of power in the world."

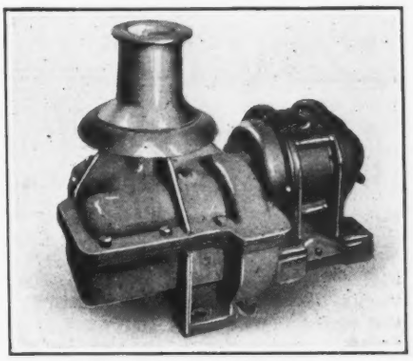
The 208,000-kw. turbine-generator unit includes a high-pressure element and two low-pressure ones, so connected that the sections can be operated independently, should such be desired. Steam is admitted to the high-pressure, 76,000-kw. element at 600 lbs. pressure and 730 deg. F. From there, at reduced pressure and temperature, the steam passes to a reheater using live steam. After being raised to a temperature of 500 deg. F. by the live steam, it is divided and passed to the two other turbines, each rated at 66,000 kw.

An Improved Peep-Hole Door for Inspecting Furnaces

A new type of peep-hole door for boiler furnaces and oil stills has been put out recently by the Springfield Boiler Co., of Springfield, Ill. As shown in the illustration, the door consists of a square iron frame with a 5-in. round opening and a revolving shutter having the three following positions: Closed, in which the opening is covered by an iron plate; inspection position, in which a specially colored glass covers the opening so that true conditions may be ascertained without glare or uncomfortable heat; third, the open position, allowing the insertion of a steam lance or slice bar.

Helps Firebox Inspection

The illustration shows the peep-hole door in closed position. The device is easily installed on the fire or inspection door, or it may be placed on the brickwork without any serious changes in the refractory lining.



Has a Wide Working Range

Many jobs can be found for this capstan because of its 360-deg. working radius. It is built in two sizes adapted to moving from one to six cars at a time.

Car Spotter Saves Labor

There are many uses for a small, self-contained and compact motor-driven capstan around a mine, especially around the shaft and at sidings where railroad cars have to be spotted. During the stormy days of the winter months when the cars are hard to move because of the packing in the journal boxes stiffening or snow and ice on the tracks, other means of moving cars than by man-power is an economical addition to the mine equipment.

The H. W. Caldwell & Son Co. of Chicago, Ill., announce two sizes. No. 1 and No. 2, of the car spotter shown in the accompanying illustration. The former has a speed of 40 to 60 ft. per minute when moving, one, two, or three cars; the latter size will move three to six cars at a speed of from 26 to 42 ft. per minute. Sturdy construction, good material, automatic oiling and a reliable motor admirably adapt this car spotter to this class of work.

Largest Generators Yet Planned

Two electric generators, each nominally rated at 90,000 kw. at 90 per cent power factor or 100,000 kw. at unity power factor, the world's largest in both capacity and physical dimensions, and to be driven by the two largest tamden-compound turbines ever made, are being made by the General Electric Co. for the Southern California Edison Co. Two unusual features have been incorporated in these machines. The armatures are being built with special heavy construction so as to be gas-tight, for the possible future adoption of the new system of hydrogen cooling. The machines are also the first to combine a double-flow low-pressure end and four vertical condensers; with advantages of a simplified foundation and increased space for removal of condenser tubes.

The armatures of these generators, each weighing 330,000 pounds, are of such size that they will be assembled at Los Angeles. Even if railroad cars with a capacity of 165 tons were available, shipment by rail would still be impossible because of track, bridge and tunnel clearances. The turbines are of the tandem-compound type.

The Market Report

Copper Strengthens After Sag to 14c.

Organization of Exporters Reverses Downward Trend—Week's Sales Large—Zinc and Lead Quiet

New York, Oct. 13, 1926—Extremely active copper buying following several weeks of dullness was the feature of the metal markets for the week ended today. Prices ranged as low as 14c. delivered, but closed firm today at 14.125c. in Connecticut. Lead and zinc have not been active, and prices are easier if anything. Silver continues weak, but quicksilver rose as a consequence of the recent sale of the entire Spanish output for 1926, and 1927 antimony is slightly stronger.

The fact that Oct. 12 is a legal holiday in the state of New York, but not in Missouri, accounts for the absence of quotations for the New York markets but not for St. Louis, on that date.

Daily Prices of Metals

Oct.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
7	13.875	69 25	71.375	8 50	8.30	7.30@7.325
8	13.775	68 875	70 875	8 50	8 25	7.25@7.30
9	13.775	68.875	70 875	8 50	8.25	7 275
11	13.775	68.50	70 50	8.50	8.20	7.275@7 30
12	Holiday	.....	.....	....	8 20	7.30
13	13.90	68 25	70 00	8.35	8.15@8.175	7 30
Av.	13 820	68 750	70 725	8 470	8 227	7 292

The prices correspond to the following quotations for copper delivered: Oct. 7th, 14.125c.; 8th, 9th and 11th, 14.025c.; 12th, Holiday; 13th, 14.15c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Oct.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
7	57½	58⅜	65¾	318½	306¾	30 15/16	30¾	34	33⅞
8	57⅜	58⅛	65½	315¼	303½	30 7/16	30 5/16	33 15/16	33 13/16
11	57⅝	58⅜	65¾	315	303⅝	30 9/16	30 7/16	34 3/16	34 1/16
12	58	58⅞	66	312¼	301¾	30½	30⅜	34⅛	34⅛
13	58⅞	59¾	66½	312¼	301¾	30¾	30⅜	34 3/16	34 3/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Oct.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
7	4.84⅝	56⅛	26	84s11½d	11	4 84⅝	56⅜	25 15/16	84s11½d
8	4 84⅝	55¾	25 11/16	84s11½d	12	Holi day		25¾	84s11½d
9	4.84⅝	56	25 13/16	...	13	4.84⅝	56⅛	25 15/16	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper 14⅛c. Delivered

The announcement on Monday evening, Oct. 11, of the incorporation of Copper Exporters, Inc., and of the tacit approval of the Federal Trade Commission to the plans of American copper producers and associates in Europe, came at a time when the domestic market had sagged close to 14c. delivered in the Connecticut Valleys. Large sales at that figure were made on Monday and on the preceding Friday, although on the same days 14.025c., 14.05c., and even 14.10c. were realized. The announcement had an immediate effect in London, and yesterday and today the quotations registered a net gain of £1 5s. for spot Standard, £1 7s. 6d. for future Standard, and 15s. for Electrolytic. Today several domestic sellers were hesitant about making quotations, but at least two of them entered the market in the morning and did a good business at 14⅛c. delivered in the Connecticut Valleys. One other producer sold at the same level this afternoon.

The sales during the week were fairly distributed over the five selling days, no business being reported on Columbus Day. It is necessary to go back several months to find a week in which the total transactions equal those of the week ended today, the buying having been done for the remainder of the year and to some extent for January delivery. All classes of consumers participated in the movement. Prior to today f.a.s. business was done at 14c. to 14.05c., and 14.10c. for November, December, and January has been done today.

On Oct. 6, the American Brass Co. cut its prices on semi-manufactured products by about one-quarter cent, this reduction bringing their prices to a basis of 14.25-cent copper.

Lead Price Weakens Further

Late this afternoon the American Smelting & Refining Co. reduced its contract price for New York lead from 8.50 to 8.35c. The reduction came as somewhat of a surprise to the trade, as London made a modest advance today. However, the Smelting company's price has recently been shaded slightly by others, particularly for November shipment, and sales for the week have been of exceedingly modest proportions. Sales at concessions from the 8.50c. level, which obtained until today, were limited to a few small lots. The St. Louis market has been as quiet as that in the East, with the leading seller reducing his price successively to 8.25, 8.225, 8.20, and today to 8.175c. One of the smaller producers is reported to have offered small tonnages at somewhat below these levels in an effort to tempt buyers.

Practically all inquiries have been for prompt shipment, and only one sale for

November is reported all week. Some buyers are asking to have October lead shipped as soon as possible, and the active consumption in the United States is evidently continuing.

Zinc Stocks Reduced

Activity in the zinc market has been only moderate, the price ruling between 7.25c. and 7.325c., with the bottom reached on Friday. High-Grade is quoted at 9.25c., New York, with business confined principally to carload shipments. Brass Special continues to be plentiful, with the quoted premium at 5 points. Statistics for September just issued by the American Zinc Institute show a decline of 2,500 tons in stocks. The complete figures follow in tons of 2,000 lb.:

Stock, Sept 1	18,164
Produced	52,144
	70,308
Shipped	54,609
Stock, Sept. 30	15,699
Shipped from plant for export	4,225
Stored for customers	210
Retorts operating Sept. 30	87,028

Tin Market Quiet

Practically no interest has been taken in tin this week and prices have been somewhat easier. Consumers feel that in spite of limited supplies, tin prices are not likely to go counter to the general trend in other metals. Forward shipment is still from 1 to 3¼c. below the price asked for prompt Straits.

Silver Unsteady

Sales by India as well as China forced prices down to new lows for the year on Oct. 8. Since that date India has been on the buying side, but the recovery has been slight and the market closes quiet, with tendency uncertain.

Mexican Dollars (Old Mexican pesos): Oct. 7th, 42⅝c.; 8th, 42¼c.; 9th, 42½c.; 11th, 42¼c.; 12th, holiday; 13th, 42⅝c.

Lire Advance

Strength in lire featured the foreign exchange market. Closing cable quotations on Monday, Oct. 11th, were as follows: francs, 2.88¾c.; lire, 4.11¼c.; and marks, 23.81c. Canadian dollars, ⅞ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Both 98 and 99 per cent grades quoted at 27c. per lb. London, £107 per long ton for domestic metal.

Antimony—Per lb., duty paid, New York: Chinese brands, spot, 13¾@14c.; November 13⅞c.; December 13¾c. Cookson's "C" grade, 17¾@18c. Needle and oxide nominally unchanged from quotations in the Oct. 9 issue.

Bismuth—Per lb., New York, in ton lots, $2.70@$2 75. London, 10s.

Cadmium—Per lb., New York, 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per oz., $125@$135 for 98 @99 per cent. Firm. London. £63@ £65 in iridio-platinum; £50@£55 for sponge and powder.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per oz., $55@$65. London, £17@£20.

Palladium—Per oz., $68@$70. Pure metal as a constituent of crude platinum, $55@$60 per oz. London £12@ £15, nominal.

Platinum — Official price on refined metal, $112 per oz. Open market cash sales of large lots, $107. Pure metal as a constituent of crude platinum, $106.

London, £23½ per oz. for refined and £21@£22 for crude.

Quicksilver — Per 75-lb. flask, $97 @$98. San Francisco wires $94.33; steady. London, £16½.

The market has stiffened as a consequence of the purchase of the Spanish output for 1926 and 1927 by a strong syndicate at a price reliably reported as £14 per ton at the mines. Holders are unwilling sellers, in anticipation of further advances.

Ruthenium—Per oz., nominally $50@ $60.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tantalum, Tellurium, Thallium, Tungsten**, and **Zirconium** are unchanged from the issue of Oct. 9.

Metallic Ores

Tungsten Ore — Per unit of WO_3, N. Y.: Wolframite, $10.50@$10.75; Western scheelite, $10.75@$11.

Chrome, Iron, Manganese, Molybdenum, Tantalum, Uranium, and **Vanadium Ores** are unchanged from quotations in the Oct. 9 issue.

Zinc and Lead Ore Prices Low

Joplin, Mo., Oct. 9, 1926

Blende	Per Ton
High	$53.40
Premium blende, basis 60 per cent zinc	$49.00@$50.00
Prime Western, basis 60 per cent zinc	$48.00
Fines and slimes, 60 per cent zinc	$47.00@$45.00
Average settling price, all zinc	$48.17
Galena	
High	$111.60
Basis 80 per cent lead	$105.00
Average settling price, all lead	$110.98

Shipments for the week: Blende, 14,-558; calamine, 35; lead, 2,853 tons. Value, all ores the week, $1,019,520.

Buyers of zinc concentrate lowered the price on all grades this week $1 per ton. The shipment was 1,560 tons less than the production, adding that tonnage to stocks in the bins.

The marking down of the price of pig lead caused the $5 per ton lower price offerings for this concentrate. The shipment represents a tonnage sold before the decline in price.

Platteville, Wis., Oct. 9, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$51.75
Lead Ore	
Lead, basis 80 per cent lead	$110.00

Shipments for the week: Blende, 1,-155 tons; lead, none. Shipments for the year: Blende, 42,928; lead, 1,566 tons. Shipments for the week to separating plants, 2,242 tons blende.

Non-Metallic Minerals

Magnesite — Per short ton, f.o.b. California mines, grade "A" calcined, 80 per cent through 200 mesh, white, for plastic purposes, $45 per ton. Market fair.

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fuller's Earth, Fluorspar, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the Oct. 9 issue.

Mineral Products

Arsenious Oxide (White Arsenic)— 3¼c. per lb. Demand continues fair but prices show no change. London, £13 per long ton.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and **Zinc Oxide** are unchanged from prices in the Oct. 9 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per long ton, furnace, prompt and future. Spiegeleisen unchanged from Oct. 9 issue.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the Oct. 9 issue.

Metal Products

Rolled Copper — Sheets, 22¾c.; wire, 16¼c. per lb., f.o.b. mill.

Lead Sheets—Full rolled, 12¼c. per lb.; clipped, 12½c.

Nickel Silver—29¾c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal — Dimension sheets, 20¼c. per lb.; rods, 17¼c. per lb.

Zinc Sheets — 11¾c. per lb., f.o.b. works.

Refractories

Fireclay Brick, Chrome Brick, Magnesite Brick, Silica Brick and **Zirkite** are unchanged from quotations in the Oct. 9 issue.

Steel and Pig Iron Firm—Coke Quiet

Pittsburgh, Oct. 12, 1926

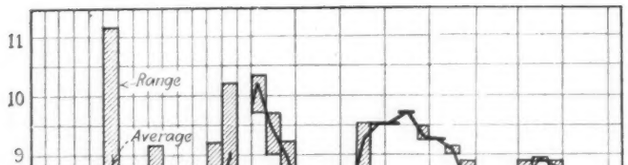
Freight-car orders in the last three weeks total 8,100 cars, following six months of scarcely any buying, and inquiries are pending or about to be issued for about 10,000 cars.

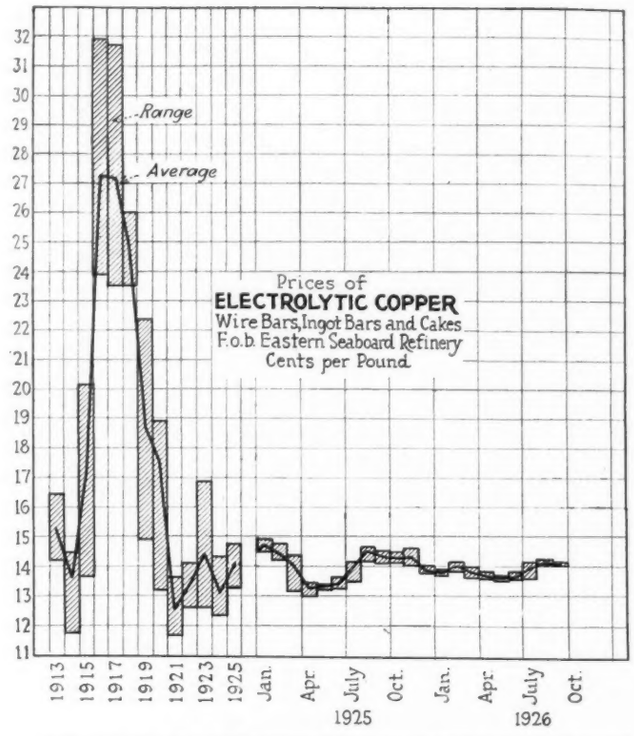
A moderate amount of business is being booked in sheets at prices as recently advanced. Merchant bars are now moving commonly at 2.10c. in the case of small lots, 2.00c. remaining the large lot price.

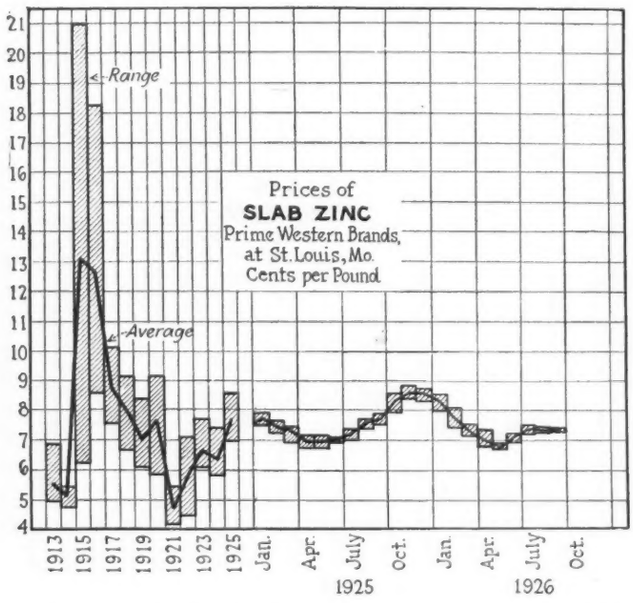
Pig Iron—Bessemer iron at Valley furnaces is now firm at $19, having been firming up in the last three weeks. Basic remains nominal at $17.50. Foundry and malleable are $18@$18.50, the $17.50 price having recently disappeared. Most sellers are quoting $18.50.

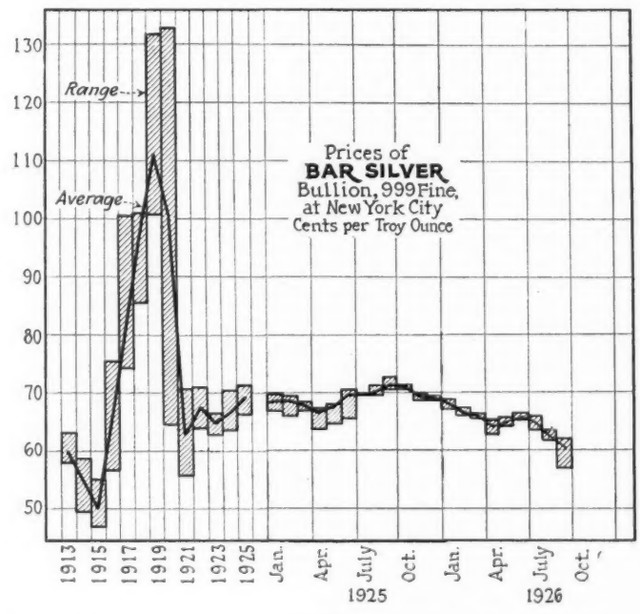
Connellsville Coke—Offerings are very light, on account of the heavy demand for coal at good prices, but coke demand is light. Spot furnace, $3.50@ $3.75; spot foundry, $4.25@$4.75.

Metal Price Curves

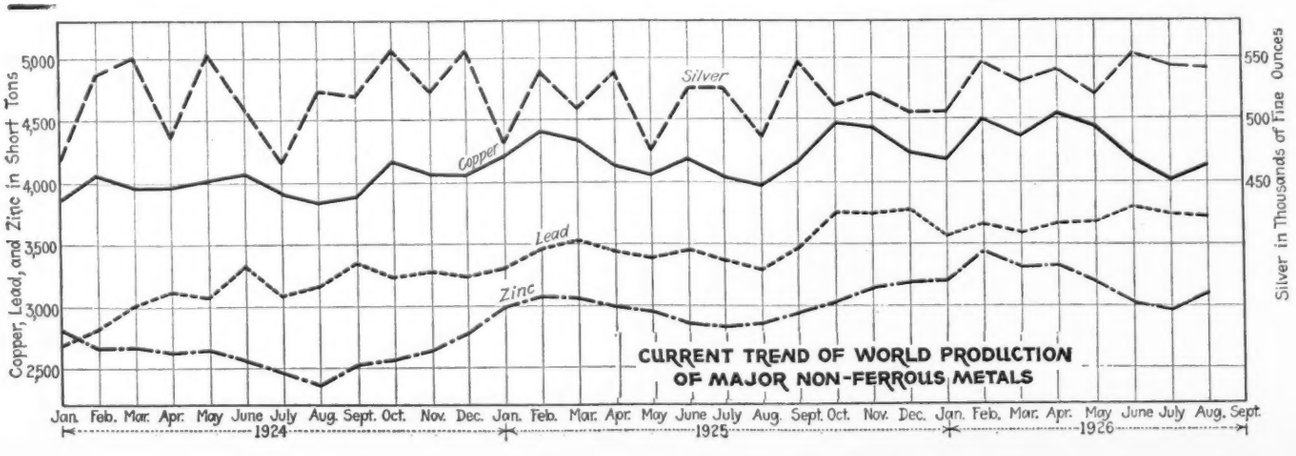



Range
Average
Prices of
ELECTROLYTIC COPPER
Wire Bars, Ingot Bars and Cakes
F.o.b. Eastern Seaboard Refinery
Cents per Pound
1913 1915 1917 1919 1921 1923 1925 Jan. Apr. July Oct. Jan. Apr. July Oct.
1925 1926





THE curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1924 and 1925 about 97 per cent of the world's output of copper; 78 per cent of the lead; 87.5 per cent of the zinc; and 81 per cent of the silver.


Copper, Lead, and Zinc in Short Tons
Silver in Thousands of Fine Ounces
Silver
Copper
Lead
Zinc
CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept.
1924 1925 1926

Review of Current Statistics

By Arthur B. Parsons
Assistant Editor

EVEN a Judge Gary on his eightieth birthday would find it difficult to find much of a bullish complexion, from the point of view of the mining industry, in the statistical data for September. The Weighted Index of Non-Ferrous Metal Prices that had been going up steadily since May, in conformity to the trend of the preceding year, reversed itself and declined almost to the level of July.

It is true that the biggest single factor in the drop was the lower price for silver, but this was partly offset by some enhancement in zinc and tin prices, leaving copper and lead as important contributors to the net loss. Moreover, the first ten days in October have witnessed still further recessions in silver, copper, and lead, so that unless some radical change for the better materializes soon, the index for October will be still lower.

Metal Prices Higher Than General Commodity Level

In comparing prices with those of September a year ago it will be observed that each of the four major metals, copper, lead, silver, and zinc, is at a level materially lower. In this connection, however, the decline in the general commodity level during the year must be taken into account. If the *E. & M. J.* metal index for September, 1926, were adjusted so as to reflect the decline in the Department of Labor commodity index it would be 117.5, compared with 114.66 in September, 1925. In other words, metals are in a better position than they were a year ago in comparison with general commodities.

The chart shows no single erratic month since January, 1925, so that one having a disposition to take a gloomy view might argue that the trend now should be downward for several months at least. He would find vigorous opposition to this contention, of course.

The long awaited and frequently deferred official announcement of the formation, with the tacit sanction of the Federal Trade Commission, of a co-operative organization of copper producers is counted on to bolster up the copper market. Copper Exporters, Inc., as it is to be known, is headed by C. F. Kelley, of Anaconda, and includes virtually all of the American producers as members, with a group of "foreign associates."

Better business and somewhat higher prices for feldspar are responsible for the improvement in the rather sensitive Weighted Index of Non-Metallic Mineral Prices. No change is reported in the other members of this group. One change of interest is the boost of $2 per ton in the price of sulphur for export, the domestic price scale remaining unchanged. Sulphur, however, is not included in the calculation of our index number.

Mining-company shares fared badly on the stock exchanges during September, each of the groups losing more ground than they had previously gained during August. Indeed, except for the coppers, they approached closely the levels of July 1. As the general share market was strong rather than weak, the decline in mining issues before Sept. 1 must be attributed to the metal situation.

Without exception, the seven mining-smelting-manufacturing companies suffered. Anaconda, with its huge capitalization, and New Jersey Zinc, with a wide quotational drop, were the biggest contributors to the decline, with A. S. & R. next. The Smelting company has been hit rather hard since the figures on which the curves are based were compiled. New Jersey Zinc is not an active stock, and not much significance is seen in fluctuations in the quotations. The stock is on the New York Curb.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	134.38
Average 9 months, 1925	110.49
Average 9 months, 1926	108.90

	1925	1926
April	104.75	105.93
May	105.34	105.43
June	107.19	106.68
July	108.81	109.08
August	113.61	110.22
September	114.66	109.27

Two of the copper stocks went counter to the general trend and by so doing moderated the effect on the group index. These were Miami, which has been going up rather consistently for some time as a consequence of its success in winning a profit from its low-grade ores; and Granby, which, following two months of gradual strengthening, took a rather sensational jump in September. Granby bids fair to become a real copper-mining enterprise and to resume the payment of dividends, according to the wise ones. Among those that lost the most ground are New Cornelia, United Verde Extension, and Calumet & Arizona. Chile, with its 4,391,245 outstanding shares, affected the index number, though the quotational decline was not large.

Miscellaneous Shares Erratic

In the gold-silver-lead-zinc group the changes were wide, and, incidentally, in both directions. Howe Sound, producer of copper, silver, lead, zinc, and gold, was the big gainer, followed by Homestake, the fifty-year-old producer of gold. Premier and Federal Smelting & Refining, both A. S. & R. subsidiaries, advanced fractionally.

Cerro de Pasco followed a good gain in August by a drastic drop in September. To the weak silver market and the future prospects for silver probably can be attributed most of Cerro de Pasco's fall. It is the largest producer of silver from a single group of mines in the world, and its program of expansion calls for still greater silver production from leaching "low-copper" ores. It's earning power obviously is affected by wide fluctuations in the price of silver.

Northern Ontario gold shares eased somewhat, as did those of the Utah silver-lead properties, Tintic Standard, Utah-Apex and Silver King Coalition. St. Joe Lead suffered a much more serious decline. The recent semi-annual report showed a falling off in earnings of about $1,500,000, but this is largely accounted for by the fact that taxes were provided for, whereas they were not in the earlier report.

Metal Stocks Down; American Deliveries Higher

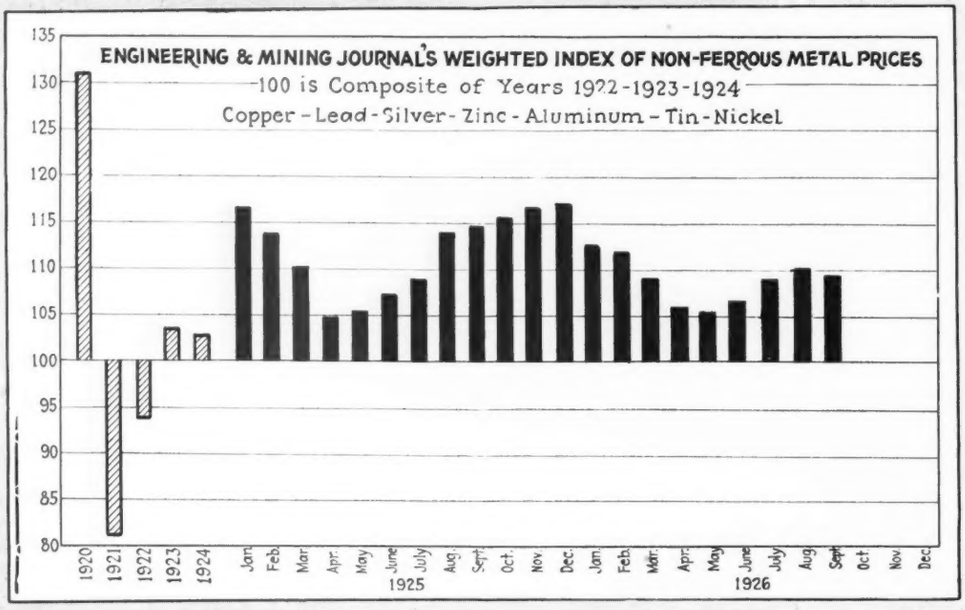
Tonnage statistics as distinguished from those involving money are more cheerful. The latest available figures show declines in stocks of each of the three major metals. Although the supply of refined copper in the hands of producers on Sept. 1 was higher, a big drop in blister and "in-process" stocks made a net reduction—a reduction, incidentally, that has been repeated for three months. "But what difference do these figures make?" wail the producers, and it must be admitted they do not seem to have any bouyant effect on the price. Domestic deliveries in August were higher than in July, but the foreign shipments drag along, disappointingly, with little change.

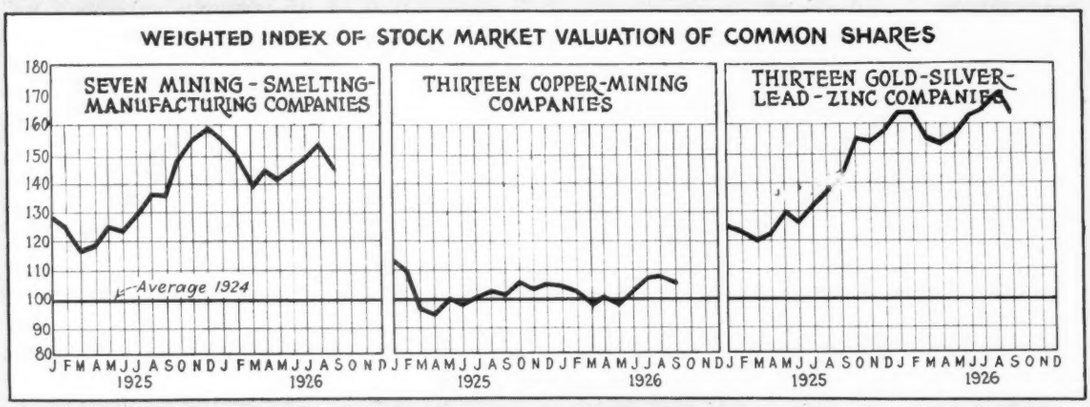
Zinc production likewise was higher in August, but the stocks in the United States continued to decline by virtue of a big increase in domestic deliveries. These in fact established a new high post-war record.

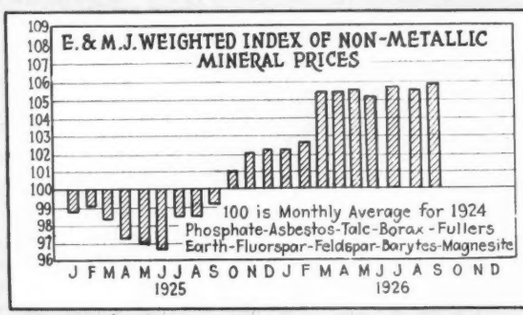
The rate of lead production from smelters in Mexico and the United States as well as in the world continues at a high but fairly uniform figure. The stocks on Aug. 1 showed a sizable decline, but it is not unlikely that the data for Sept. 1 will alter the picture. The curve shows unusually large stocks in the hands of smelters and refiners in the United States and Mexico during the last five months.

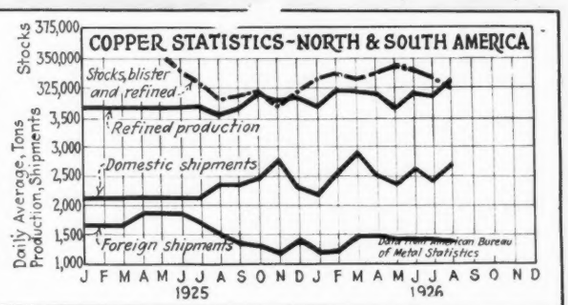
Doubtless the most disconcerting feature of the metal markets at the moment is the silver situation. As this is written silver is quoted at 55⅞c.; it averaged 69.065c. during 1925. Without endeavoring to enumerate, much less analize the many factors that may influence the price, it is fair to say that an average of less than 59.065 is quite possible for the next year. Mines financed largely by American capital produced about 200,000,000 oz. of silver in 1925. If the price realized on this quantity of metal were reduced only 10c. per ounce, $20,000,000 in earnings of American mines would be wiped out, without a chance for any compensating reduction in the cost of production. This is one way to state the silver problem—and there is no sense in trying to avoid looking it squarely in the face.

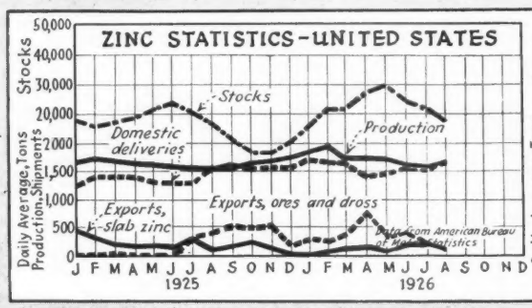
E.&M.J. Statistics of the Mining Industries

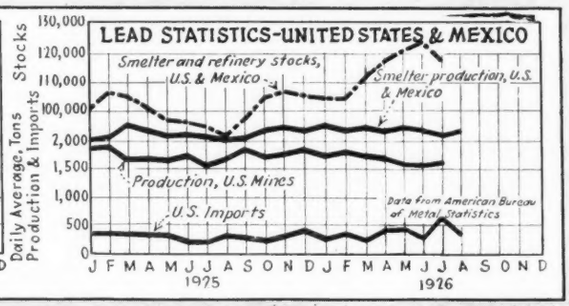

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922-1923-1924
Copper - Lead - Silver - Zinc - Aluminum - Tin - Nickel
1920 1921 1922 1923 1924
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1925
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1926


WEIGHTED INDEX OF STOCK MARKET VALUATION OF COMMON SHARES
SEVEN MINING - SMELTING-MANUFACTURING COMPANIES
Average 1924
THIRTEEN COPPER-MINING COMPANIES
THIRTEEN GOLD-SILVER-LEAD - ZINC COMPANIES
J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926


E. & M.J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate-Asbestos-Talc-Borax - Fullers Earth-Fluorspar-Feldspar-Barytes-Magnesite
J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926


COPPER STATISTICS - NORTH & SOUTH AMERICA
Stocks
Stocks, blister and refined
Daily Average, Tons Production, Shipments
Refined production
Domestic shipments
Foreign shipments
Data from American Bureau of Metal Statistics
J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926


ZINC STATISTICS - UNITED STATES
Stocks
Stocks
Domestic deliveries
Production
Daily Average, Tons Production, Shipments
Exports, slab zinc
Exports, ores and dross
Data from American Bureau of Metal Statistics
J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926


LEAD STATISTICS - UNITED STATES & MEXICO
Stocks
Smelter and refinery stocks, U.S. & Mexico
Smelter production, U.S. & Mexico
Daily Average, Tons Production & Imports
Production, U.S. Mines
U.S. Imports
Data from American Bureau of Metal Statistics
J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926

Copper Producers Finally Launch Export Association

Organization Incorporated as "Copper Exporters, Inc."—C. F. Kelley Explains Purposes—Trade Commission Approval Seems Assured

Copies of the incorporation papers and by-laws of the Copper Exporters, Inc., were filed on Oct. 12 with the Federal Trade Commission under the provisions of the Webb-Pomerene Act.

For many weeks, officials of the Federal Trade Commission have been conferring with the copper men, the way being paved to the formation of a corporation that would function in a similar manner to the export corporations that have been organized for many other commodities.

Approval Likely

On the basis of such papers it appears probable that the commission will give approval to the proposed combination, although such approval with respect to any organization under the Webb-Pomerene Act would be no avail against penalties for possible future infractions of the law. It carries with it no guarantee.

Under the Webb-Pomerene Act the copper men can organize for export trade without coming under the general provisions of the Sherman Anti-Trust Act and continue operations so long as the association keeps within the requirements of the Webb-Pomerene Act, it is said.

Cornelius F. Kelley, president of the Anaconda Copper Mining Co. will head the new body. After a meeting of the executive committee of the copper exporters' organization yesterday the following statement was issued:

"The Copper Exporters, Inc., is an organization of American copper producers associated with whom are certain foreign producers and sellers of copper.

Would Eliminate Foreign Speculation

"The purpose of the organization is to endeavor to eliminate in foreign countries the harmful speculation that causes wide fluctuations in price, unwarranted by industrial factors in European markets, and tends to destroy confidence in the integrity of such price and the stability of the business. The operations of Copper Exporters, Inc., are entirely within the limitations fixed by the Webb Act and amendments thereto, under which American producers of any commodity may join the marketing of their product in foreign markets.

"The need for such an organization must be manifest to anybody who has followed the trend of the foreign copper market, especially since the war. Wide fluctuations in prices, working hardships on producers and consumers alike, speculative movements engineered by foreign dealers who have no financial interest in the production of the metal, have produced a situation in foreign markets intolerable from the producers' point of view.

"Under the operation of Copper Exporters, Inc., copper prices in Europe will be established in accordance with general business conditions as they develop from day to day.

"The effort will be made to sell direct to consumers except where conditions make it desirable, in facilitating export trade, to sell to distributers. An effort will be made to eliminate harmful speculation in copper.

"It is the intention to keep the proper governmental authorities at all times fully advised of the operations of the association.

"The respective committees are now engaged in perfecting the organization for the active transaction of business which will begin at as early a date as possible.

Large Membership Both Here and Abroad

"Following are the members, foreign associates and officers of Copper Exporters, Inc.:

"Members—American Metal Co., Ltd.; American Smelting & Refining Co., Anaconda Copper Mining Co., Calumet & Arizona Mining Co., Calumet & Hecla Consolidated Copper Co., Copper Range Co., Inspiration Consolidated Copper Co., International Minerals & Metals Co., Kennecott Copper Corporation, Mother Lode Coalition Mines Co., Nevada Consolidated Copper Co., New Cornelia Copper Co., Nichols Copper Co., Old Dominion Co., Phelps Dodge Corporation, Quincy Mining Co., Utah Copper Co., United Verde Copper Co.

"Foreign Associates—Aaron Hirsh & Sohn, British Metals Corporation, Cerro de Pasco Copper Corporation, Chile Copper Co., Granby Consolidated Mining, Smelting & Power Co., Greene Cananea Copper Co., Mansfeldscher Metallhandel A. G., Mansfield Aktiengesellschaft fur Bergbau und Hüttenbetrieb, Metallgesellschaft, Rio Tinto Co., Société Générale Metallurgique de Hoboken, Société Générale de Minerals, South American Products Co., Union Minière du Haut-Katanga.

"Directors—C. F. Kelley, Anaconda Copper Mining Co.; F. H. Brownell, American Smelting & Refining Co.; C. M. Loeb, American Metal Co., Ltd.; C. E. Dodge, Phelps Dodge Corporation; C. W. Nichols, Nichols Copper Co.; R. L. Agassiz, Calumet & Hecla Consolidated Copper Co.; J. H. Anderson, United Verde Copper Co.; C. A. Wilson, John de R. Storey.

"Officers — President, C. F. Kelley, Anaconda Copper Mining Co.; vice-president, F. H. Brownell, American Smelting & Refining Co.; executive vice-president, J. Clendenin, Kennecott Copper Corporation; vice-presidents, L. Vogelstein, American Metal Co., Ltd.; T. Wolfson, Metals Sales Corporation; C. A. Austin, Phelps Dodge Corporation; H. M. Brush, American Smelting & Refining Co.; secretary, John de R. Storey; treasurer, C. V. Welch."

Improved Metal Outlook in Germany

The gradual improvement of conditions in Germany, says the *Metal Bulletin* of London, is reflected by the fact that the German unfavorable balance of trade in August has been reduced to 86 million marks as compared with 121 millions in July, but for the main part this improvement was due to increased exports of coal—one of the results of the miners' strike in England—and to smaller imports of foodstuffs. Imports of all raw metals increased slightly, while exports of electro-technical articles again showed an advance. The occupation of the electrical industry should improve during the months to come, as it may be mentioned that the greater part of the big loans which Germany recently arranged abroad will be needed for the electrification of this country. This is the case with the $20,000,000 contracted by the Prussian States, with the $24,000,000 arranged by the Siemens combine and with the $3,000,000 taken up by the Leipzig power plant. The idleness in the metal-consuming industry is decreasing slowly, and while in July 21.7 per cent of the workers were idle, at the end of August only 20.9 per cent were unemployed, while 24.0 against 26.2 per cent were working on a short time basis. Of course, it must not be overlooked that generally in the autumn business improves, but so far only small signs of this can be seen. Consumers continue to buy on a hand-to-mouth basis and only against the booking of orders, so that stocks in consumers' hands are not important.

Sales of copper have been reduced to a minimum, and the reduction of the selling quotation of the American agencies after remaining stable for four weeks has not helped to improve the situation. Consumers remained reluctant, both the cable works and the brassmakers showing almost no interest. The Hirsch Copper and Brass Works give an illustration of the situation in that branch in saying that owing to the general conditions in the rolling industry and with the makers of metal hardware, selling prices have been unsatisfactory. The Hirsch Co. reports that its mills were satisfactorily busy during all the year and that its activity has increased during recent months.

Park Utah Consolidated Earnings

Park Utah Consolidated Mines Co. reports for six months ended June 30, 1926, total income of $2,404,438 and net earnings after operating expenses $897,427. After deductions of taxes, depreciation and depletion and after taking out $628,050 representing dividends paid and accrued, surplus for the period was $118,858.

Mining Stocks—Week Ended October 9, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	49⅞	46⅛	47	Oc.16, No.22 Q	0.75
Arcadian Consol.	Boston	....	....	*90	....	....
Ariz. Com'l.	Boston	10½	10	10	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb	1⅜	1⅜	1⅜	....	....
Calumet & Arizona	New York	68	65½	66⅜	Se. 4, Se. 20 Q	1.50
Calumet & Hecla	Boston	17½	16½	17	Au.31, Se.15	0.50
Cerro de Pasco	New York	64⅜	62⅞	63¼	Jy. 15, Au.2, Q	1.00
Chile Copper	New York	33⅛	31⅝	32	Oc.14, No.1, Q	1.00
Chino	New York	24⅝	24¼	24⅜	....	....
Con. Coppermines	N. Y. Curb	3	2⅞	3	....	....
Copper Range	Boston	15½	15	15	May, 1925	1.00
Crystal Copper	Boston Curb	*48	*35	*40	....	....
East Butte	Boston	3	2⅛	2⅛	Dec., 1919	0.50
First National	Boston Curb	...	...	*12	Feb., 1919	0.15
Franklin	Boston	...	...	*40	....	....
Granby Consol.	New York	31½	29	29½	May, 1919	1.25
Greene-Cananea	New York	21	19⅜	19¾	Nov., 1920	0.50
Hancock	Boston	...	...	1	....	....
Howe Sound	New York	42⅜	40½	41	Oc.1, Oc.15 Q	1.00
Inspiration Consl.	New York	25⅜	23⅞	24½	Se.16, Oc.4, Q	0.50
Iron Cap	Boston Curb	4	3½	3½	....	....
Isle Royale	Boston	11½	11	11	Jn. 1, Jn. 15	0.50
Jerome Verde Dev.	N. Y. Curb	...	...	*51	....	....
Kennecott	New York	61⅛	59	60	Sept. 3, Oct. 1 Q	1.00
Lake Copper	Boston	...	...	*80	June, 1925	0.50
Magma Copper	New York	38⅜	36⅜	37⅛	Oc.1, Oc.15, Q	0.75
Mason Valley	N. Y. Curb	2¼	2⅛	2¼	....	....
Mass Consolidated	Boston	...	...	*30	Nov., 1917	1.00
Miami Copper	New York	17⅛	16	16⅜	No.1, No.15 Q	0.37½
Mohawk	Boston	41⅛	40⅜	40⅜	Jy.31, Se.1 Q	1.00
Mother Lode Coa.	New York	5⅜	5⅛	5⅛	Jn. 15, Jn. 30	0.37½
Nevada Consol.	New York	15⅛	14⅛	14⅜	Oc.14, Nov.16	0.25
New Cornelia	Boston	22⅛	21⅛	21⅛	Au 6, Au.23 Q	0.40
North Butte	Boston	3⅛	2⅞	3	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*50	*42	*42	Se. 1, Se. 15	0.05
Old Dominion	Boston	17⅛	17⅛	17⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†135	†132	....	Se.25, Oc.2 Q	1.50
Quincy	Boston	19½	18⅛	18⅛	Mar., 1920	1.00
Ray Consolidated	New York	15⅜	14⅛	15	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb	...	...	11⅞	....	....
St. Mary's Min. Ld.	Boston	28	26	27	Ap.17, My.18	2.00
Seneca Copper	New York	5	4⅛	4⅛	....	....
Shannon	Boston	...	...	*40	Nov., 1917	0.25
Shattuck-Denn	Boston Curb	6⅛	5⅛	5⅛	....	....
Superior & Boston	Boston	...	...	*40	....	....
Tenn. C. & C.	New York	12	11⅛	11⅛	Au.31, Se.15, Q	0.25
United Verde Ex.	N. Y. Curb	26⅛	25⅛	25⅜	Oc.16, No.1, Q	0.75
Utah Copper	New York	106⅛	106⅛	106⅛	Se.3, Se.17 Q	1.75
Utah Metal & T.	Boston	1⅜	1⅛	1⅛	Dec., 1917	0.30
Victoria	Boston	*50	*50	*50	....	....
Walker Mining	Salt Lake	...	...	*55	....	....
NICKEL-COPPER						
Internat. Nickel	New York	36⅞	35⅛	35⅛	Se.7, Se.30, Q	0.50
Internat. Nickel, pfd.	New York	103	103	103	Oc. 14, No.1,	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*31	*29⅜	*30	Sept., 1926	0.005
National Lead	New York	153½	148	148½	Sept., 1926	Q2.00
National Lead pfd.	New York	116	116⅜	116	Sept., 1926 Q	1.75
St. Joseph Lead	New York	41	39½	40	Sept., 1926 QX	0.75
ZINC						
Am. Z. L. & S.	New York	6½	6⅛	6⅛	May., 1917	1.00
Am. Z. L. & S, pfd.	New York	32½	30⅛	32	Nov., 1920	1.50
Butte C. & Z.	New York	5	4⅛	4⅛	De.10, De.24	0.50
Butte & Superior	New York	10	9⅝	9⅝	Se.15, Se.30 Q	0.50
Callahan Zn-Ld.	New York	2	1⅞	2	Dec., 1920	0.50
Eagle-Picher	Cincinnati	30⅞	30⅛	30⅛	Au.14, Se.1 Q	0.40
Eagle-Picher, pfd.	Cincinnati	....	....	110	Se. 30, Oc. 5 Q	1.50
New Jersey Zn.	N. Y. Curb	....	....	191	July 20, Aug. 10 Q	2.00
United Zinc	N. Y. Curb	....	....	*70	....	....
Yellow Pine	Los Angeles	....	....	*15	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1	1	1	....	....
Argonaut	Toronto	*38	*35	*37	....	....
Barry-Hollinger	Toronto	*69½	*65	*65	....	....
Carson Hill	Boston	....	....	*25	....	....
Consol. W. Dome L.	Toronto	*24⅜	*21½	*23	....	....
Cresson Consol. G.	N. Y. Curb	2 1/16	2⅛	2⅛	July, 1926	0.10
Crown Reserve	Toronto	*9½	*8⅛	*9⅛	Jan., 1917	0.05
Dome Mines	New York	10½	9⅜	9⅜	Se.20, Oc.30, Q	0.50
Golden Center	N. Y. Curb	2	1⅞	1⅞	....	....
Golden Cycle	Colo. Springs	...	....	2	Dec., 1925	0.03
Hollinger Consol.	Toronto	19.05	18.90	18.95	Se.21, Oc. 7 Q	0.10
Homestake Mining	New York	63	59¼	63	Oc.20, Oc.25 M	0.50
Kirkland Lake	Toronto	1.02	*98	*98	....	....
Lake Shore	Toronto	14.50	13.80	13 80	Se.1, Se. 15 Q	0.10
McIntyre-Porcupine	New York	24⅛	23⅞	23⅞	Au.2, Se.1 Q	0.25
Newray	Toronto	*42	*42	*42	....	....
Noranda	N. Y. Curb	19½	18⅜	19	....	....
Night Hawk Pen.	Toronto	*6½	*5⅜	*5⅜	....	....
Portland	Colo. Springs	...	....	*43	Oc.6, Oc.15	0.02
Rand Mines	New York	....	....	41⅜	Au.23-30 Am.Sh.1	52
Teck-Hughes	Toronto	4.74	4.63	4.58	Jy. 15, Au. 2	0.05
Tom Reed	Los Angeles	....	....	*55	March, 1926	0.02
Tough-Oakes	Toronto	*43	*41	*41½	....	....
United Eastern	N. Y. Curb	*58	*58	*58	July, 1924	0.05
Vipond Cons.	Toronto	1.72	1.70	1.71	....	....
Wright-Hargreaves	Toronto	8.70	8.60	8.60	Se.15, Oc.1 QX	0.07½
Yukon-Alaska Trust	N. Y. Curb	....	....	20	....	....
GOLD AND SILVER						
Carnegie Metals	Boston	14⅜	13½	13½	....	....
Con. Cortez	N. Y. Curb	*5	*5	*5	....	....
Con. Virginia	San Francisco	*6½	*6⅛	*6⅛	....	....
Continental Mines	N. Y. Curb	....	....	*48	....	....
Dolores Esperanza	N. Y. Curb	*71	*60	*61	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅜	2	2	Se.15, Oc.4 Q	0.08
Tonopah Belmont	N. Y. Curb	2⅜	2⅛	2⅛	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*24	*20	*24	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	4⅛	3⅞	4⅛	Se.30, Oc.27 Q	0.07½
Unity Gold	N. Y. Curb	....	....	*30	....	....
West End Consol.	N. Y. Curb	*13	*10	*11	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	....	....	*27	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol.	Toronto	*85	*82	*84	May. 1920	0.03
Castle-Trethewey	Toronto	1.34	1.20	1.22	....	....
Conagas	Toronto	4.35	4.30	4.35	May, 1924	0.12½
Keeley	Toronto	1.55	1.45	1.47	Se.1, Se.15 SA	0.12
Kerr Lake	N. Y. Curb	....	....	*99	Oc.1, Oc.15	0.12½
La Rose	Toronto	*8	*7	*7	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	....	....	*55	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*11	*10½	*11	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.25	2.90	2.92	Jy.1, Jy.15 SA	0.12½
Nipissing	N. Y. Curb	5⅜	5⅛	5⅜	Se.30, Oc.20 Q	0.15
Temiskaming	Toronto	*8	*8	*8	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	6¾	6½	6¾	Se.28, Oc.1, QX	0.25
Alta Merger	Salt Lake	†*4	†*2	...	....	....
Bingham Mines	Boston	36⅛	35	36	Se.20, Se.30 Q	1.00
Cardiff M. & M.	Salt Lake	*32	*27	*31	Nov., 1924	0.10
Chief Consol.	Salt Lake	2.75	2.75	2.75	Jy.10, Au.10 Q	0.10
Consti'n Mng. & Mill'g	Spokane	*60	*49	*55	....	....
Emma Silver	Salt Lake	†2	†*75	...	....	....
Erupcion	Boston Curb	1 3/16	1 1/16	1 3/16	Se., Oc.1, QX	0.15
Federal M. & S.	New York	95	87	92	....	....
Federal M. & S., pfd.	New York	73⅜	71½	72	Au.25, Se.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*15	*9	*11	....	....
Hecla Mining	N. Y. Curb	17⅜	17	17	Au.14, Se.15 Q	0.50
Highland-Surprise	Spokane	*21	*20½	*21	....	....
Iron King Mining	Salt Lake	*26	*23	*23	....	....
Keystone Mining	Salt Lake	*27	*27	*27	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*16	*16	*16	....	....
Lucky-Tiger Com.	Kansas City	†8.75	†8.40	...	Se.10, Se.20 X	0.07
Mammoth Mining	Salt Lake	2.85	2.70	2.70	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	2.25	2.12½	2.25	Se.15, Oc.19	0.15
Park Utah	New York	5.80	5.50	5.50	Se.15, Oc.1 Q	0.15
Plutus Mining	Salt Lake	2.10	2.00	2.00	July 15	0.15
Prince Cons.	Salt Lake	....	....	3	....	....
Silver King Coal	Salt Lake	7.75	7.50	7.60	Se. 20, Oc.1,	0.25
Silversmith	Spokane	*48	*46	*46	Oc.1, Oc.10 Q	2.00
Strattons Mines	Spokane	*42	*41	*41	....	....
Tamarack-Custer	Spokane	*28½	*24½	*24½	Sept., 1924	0.25
Tintic Standard	Salt Lake	11.00	10.50	10.50	Se.13, Se.25 QX	0.40
Utah-Apex	Boston	6¼	5⅞	5⅞	Oc.3, Oc.15 Q	0.25
Western Utah Copper	N. Y. Curb	....	....	*5	....	....
IRON						
Bethlehem Steel	New York	49⅞	45½	45½	July, 1924	1.25
Cleveland-Cliffs Iron	Cleveland	84	80	80	Oct., 1926	1.00
Colorado Fuel & Iron	New York	49¼	43¼	43¼	May, 1921	0.75
Gt. North'n Iron Ore	New York	20	19½	19½	Dec., 1925	0.75
Inland Steel	New York	41¼	40	40	Au.13, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅛	1⅛	1⅛	....	....
Replogle Steel	New York	9⅞	9⅛	9⅛	....	....
Republic I. & S.	New York	59½	56	56½	Au.14 Se.1	1.00
Republic I. & S. pfd.	New York	97	96¾	96¾	Se.15, Oc.1 Q	1.75
Sloss-Sheffield S. & I.	New York	128½	123	125	Se.10, Se.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	104½	104½	104½	Se.20, Oc.1 Q	1.75
U. S. Steel	New York	153⅞	142⅛	142⅛	Se.2, Se.29 Q	1.75
U. S. Steel pfd	New York	127½	127	127½	Au.3, Au.30, Q	1.75
Virginia I. C. & C.	New York	...	...	48⅛	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	...	...	72	Jn.1, July 2, SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM						
De Beers Consol.	New York	39⅛	38⅛	38⅛	Ju.16, Ju.17	1.70
So. Am. Gold & P.	N. Y. Curb	4⅜	4⅛	4⅛	....	....
Alum. Co. of Amer.	N.Y. Curb	73	69¾	71⅜	....	....
Alum. Co. of Amer pf.	N.Y. Curb	102	102⅜	102	June 15, July 1, Q	1.50
Vanadium Corp.	New York	39	37⅛	38	Au.2, Au.16, Q	0.75
ASBESTOS						
Asbestos Corp., New	Montreal	21	19⅞	20	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	76	72½	72½	Jy.1, Jy.15, SA	1.75
SULPHUR						
Freeport Texas	New York	31⅜	28⅛	28⅞	Nov., 1919	1.00
Texas Gulf	New York	46⅛	41⅞	42	Se.7, Se. 15, Q	3.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	48	46⅜	47½	Au.20, Se. 1, Q	1.00
Amer. Metal pfd.	New York	....	....	114	Au.21, Se. 1 Q	1.75
Amer. Sm. & Ref.	New York	141½	131½	131⅝	Oc.15, No.1, Q	2.00
Amer. Sm.&Ref.pfd.	New York	120	119½	120	No.5, De.1, Q	1.75
Consol. M. & S.	N. Y. Curb	....	....	300	Jn.30, Jy.5 SAX	3.75
Federated Metals	N. Y. Curb	12⅛	12	12	....	....
Newmont Mining	N. Y. Curb	76	71	73	Oc.1, Oc.15,	0.60
Southwest Metals	N. Y. Curb	....	....	1	....	....
U. S. Sm. R. & M.	New York	36	33⅞	34½	Oc.7, Oc.15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	48⅜	46⅜	47⅛	Oc 7, Oc.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED SEPT. 27, 1926

Name	High	Low	Last	Date	Last Divd. Amount
Aramayo Mines (25 frs.)	83/3	80/—	80/—	Aug. 1926	15 p.c.†
British Platinum (£1)	3/3	2/9	3/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/—	15/6	15/7½	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/—	6/6	6/10½		
Camp Bird (2s)	4/6	3/6	3/6		
El Oro (£1)	7/3	6/9	7/3	Nov. 1924	2½ p.c.*
Esperanza (10s)	—/10½	—/7½	—/7½		
Frontino & Bolivia (£1)	8/3	8/—	8/3	July 1926	2½ p.c.
Mexican Corpn. (£1)	12/9	12/—	12/—		
Mexico Mines of El Oro (£1)	25/—	23/1½	25/—	June 1926	7½ p.c.*
Oroville Dredging (£1)	3/6	3/—	3/6	ec. 1923	3¾ p.c.
Ouro Preto (£1)	2/3	2/—	2/—	May 1925	2½ p.c.
Rhodesian Congo Border (£1)	123/1½	113/9	115/—		
St. John del Rey (£1)	8/6	8/3	8/6	June 1925	6½ p.c.
San Francisco Mines (10s)	34/10½	33/7½	34/3	June 1926	15 p.c.
Santa Gertrudis (£1)	17/1½	15/7½	15/9	July 1926	5 p.c.
Selukwe (2s. 6d.)	14/3	12/10½	13/9	April 1917	6¾ p.c.
S. Amer. Copper (2s.)	4/3	3/7½	3/9	Nov. 1917	75 p.c.
Tanganyika (£1)	49/10½	46/6	47/6	Aug. 1926	7½ p.c.
Tomboy (£1)	3/9	3/6	3/9	July 1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	10.000	9.750	9.850	July 1926	175 (‡)

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.